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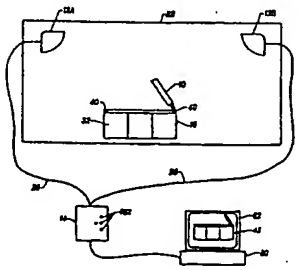
(57) Abstract

A transcription system is provided which includes a plurality of signal receivers (12A, 12B) for positioning adjacent a writing surface (28) and for receiving a position signal transmitted from the stylus (10) when the stylus is positioned adjacent the writing surface (28), the signal receivers (12A, 12B) producing timing signals in response to receiving the position signal from the stylus (10), the transcription system using the timing signals to determine a position of the stylus (10) adjacent the writing surface (28).



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TRANSCRIPTION SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a system for recording writing performed on a surface and its components and related methods where the position of a stylus used in the system to write on the surface is tracked using signals.

Description of Related Art

Existing technologies for capturing and storing handwritten notes include digitized writing surfaces such as electronic whiteboards or SMARTBOARDS™. These electronic whiteboards typically either photocopy an entire writing surface or serve as the actual input device (e.g. an electronic template) for capturing the handwritten data. The whiteboards may be active or passive electronic devices where the user writes on the surface with a special stylus. The active devices may be touch sensitive, or responsive to a light or laser pen wherein the whiteboard is the detector that detects the active signal. The passive electronic boards tend to use large, expensive, board-sized photocopying mechanisms.

As described above, whiteboard systems of the related art are large, cumbersome, expensive and immobile.

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relative to the signal receiver to reflect position signals transmitted by the stylus away from the signal receiver when the stylus is positioned adjacent the writing surface outside of an angular range of about 160 to 200 degrees extending outward from the detector parallel to the writing surface, preferably about 180 degrees.

In regard to any of the detector embodiments, at least a portion of the reflecting surface may have a curved shape such as a parabolic shape. The signal receiver may be positioned adjacent a focus of the parabolic shaped portion of the reflecting surface.

In regard to any of the detector embodiments, the detector may further comprise a mechanism for removably attaching the detector to the writing surface.

Other embodiments of detectors which may be used in the transcription system of the present invention, and variations thereof, are described herein and are intended to be encompassed within the scope of the present invention.

Various detector assemblies for use in transcription systems according to the present invention are also provided. In one embodiment, the detector assembly comprises first and second signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the first and signal receivers each producing timing signals in response to receiving the position signal.

In another embodiment, the detector assembly comprises first and second signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the first and signal receivers each producing timing signals in response to receiving the position signal; and a member coupling the first and second signal receivers, the coupling member being capable of adopting two or more configurations where a distance between the first and second signal receivers changes in at least two of the configurations.

According to this embodiment, the coupling member may be capable of telescopic expansion and contraction. The coupling member may also include a hinge by which the signal receivers can be angularly moved relative to each other. The coupling member may include at least two hinges. The coupling member may also include an attachment mechanism for removably attaching the detector assembly to a writing surface. The coupling member may optionally hold the first and second signal receivers

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In regard to any of the detector assembly embodiments, the detector assembly may further comprise a mechanism for removably attaching the detector assembly to the writing surface. An example of such an attachment mechanism is a suction cup, preferably a cam activated suction cup.

In regard to any of the detector assembly embodiments, the detector assembly may further comprise a hardware unit which receives timing signals produced by the signal receivers, the hardware unit including logic for processing the timing signals to determine a time of flight of the position signal from the stylus to the signal receivers.

In regard to any of the detector assembly embodiments, the detector assembly may also further comprise a rectifier connected in series between the signal receivers and the hardware unit such that the hardware unit receives the timing signal from the signal receivers via the rectifier.

In regard to any of the detector assembly embodiments, the detector assembly may also further comprise a comparator connected in series between the rectifier and the hardware unit such that the hardware unit receives the timing signal from the rectifier via the comparator.

In regard to any of the detector assembly embodiments, the detector assembly may be designed to be operated under battery power. For example, the detector assembly may be operated under battery power from a laptop computer. The detector assembly may also be operated under battery power having a voltage between about 1.5 and 24 volts, preferably between about 1.5 and 12 volts.

In regard to any of the detector assembly embodiments, the detector assembly may further include a power source for operating the detector assembly. The power source may be a battery. The battery may have a voltage of between about 1.5 volts and 24 volts, preferably between about 1.5 volts and 12 volts.

In regard to any of the detector assembly embodiments, the detector assembly may optionally include any of the detector embodiments described above. In particular, the detector assembly may include signal focussing elements and/or signal shielding elements.

In regard to any of the detector assembly embodiments, the detector assembly may further include a microphone. The microphone may be used in the transcription

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pre-determined level. The power level signal may be encoded into a position signal or a reference signal. The position signal may be a sonic signal.

In another embodiment, a stylus is provided which includes a position signal transmitter; and a stylus housing defining a volume for housing a removable writing element which includes a power source for providing operating power to the stylus, a portion of the volume for housing the writing element including a power source contact area for placing the stylus in electrical contact with the writing element power source. The stylus may optionally include a writing tip and a conduit for communicating writing media from the writing element to the writing tip. The stylus of this embodiment may optionally be part of a kit which includes a removable writing element including a writing element housing sized to fit within the volume of the stylus housing, writing media contained within the writing element housing, a power source for providing operating power to the stylus, and power source contacts positioned on the writing element housing such that the power source contact area is in electrical contact with the power source contacts when the writing element is positioned within the stylus housing. The present invention also relates to the writing element which includes the power source for providing operating power to the stylus.

Further according to this embodiment, the stylus and/or the writing element may include electronics which causes a signal to be transmitted by the stylus which identifies the stylus and/or the writing element as being compatible with the transcription system. In this regard, the stylus and/or the writing element may include logic for producing encoded identification signals, the transcription system also including logic for recognizing the encoded identification signals. By incorporating this feature, use of styluses and writing elements incompatible with the transcription system can be prevented by the system.

According to any of the stylus embodiments, the stylus may include a position signal transmitter for transmitting position signals, a reference signal transmitter for transmitting reference signals and/or a position signal receiver for receiving position signals.

According to any of the stylus embodiments, at least a portion of the stylus housing may be clear or opaque such that it is possible to see the writing element within the housing. The

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According to any of the stylus embodiments, stylus may further include a reference signal transmitter for transmitting a reference signal when the writing element is sensed by the contact switch to be in contact with the writing surface. The reference signal transmitter may transmit a variety of signals including infra-red signals and ultrasound signals.

According to any of the stylus embodiments, the stylus may further include a contact switch for sensing when the writing element is contacted with a writing surface, the position signal transmitter transmitting the position signal when the writing element is sensed by the contact switch to be in contact with the writing surface. According to this variation, the stylus may further include a reference signal transmitter which transmits a reference signal when the writing element is sensed by the contact switch to be in contact with the writing surface.

According to any of the stylus embodiments, the stylus may further include a cap removably attachable to the stylus housing distal end and sized to cover the portion of the writing element which extends from the stylus housing distal end. The cap preferably forms a seal with the stylus housing to prevent the writing element from drying out. The cap may be formed of a material which allows a user to observe the color of the writing element without having to remove the cap. For example, the cap may optionally be clear or opaque. Also the position signal transmitter may be positioned adjacent the distal end of the stylus housing and the cap may be sized to fit over the position signal transmitter.

Other embodiments of styli which may be used in the transcription system of the present invention, and variations thereof, are described herein and are intended to be encompassed within the scope of the present invention.

The present invention also relates to the use of a temperature sensor for measuring a temperature adjacent the writing surface. The temperature sensor may be incorporated into one or more components of the transcription systems described herein, such as writing surfaces, styluses, detectors, detector assemblies, coupling members and sub-members, attachment members, hardware units, and templates. Changes in temperature can alter the speed at which position signals travel. Measurement of temperature using the temperature sensor can be used to account for these changes.

Various transcription systems embodiments can be designed in view of the present invention. Some specific examples of transcription systems embodiments are as follows.

In one embodiment, the transcription system includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus

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surface to the furniture. For example, it is envisioned that these components of the transcription system may be incorporated into desks and other types of office furniture.

Kits for use with the various embodiments of the transcription system and its components are also provided. In its broadest sense, kits are provided which include any two same or different components of the various embodiments of transcription systems described herein. Types of components provided herein include, but are not limited to writing elements, writing surfaces such as paper, whiteboards, chalkboards, and glass, styluses, stylus caps, detectors, detector assemblies, coupling members and sub-members, attachment members, hardware units, templates, and logic in computer readable form for use in the various transcription systems.

Some specific examples of kit embodiments are as follows. In one embodiment, a kit is provided which includes first and second signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface. The signal receivers produce timing signals in response to receiving the position signal from the stylus. The kit also includes a template which is coupleable to the writing surface and which has markings defining a perimeter of at least one control section sized to have a writing portion of the stylus positioned within the perimeter of the at least one control section. The kit also includes a computer readable medium including logic for identifying when the portion of the stylus is positioned within the perimeter of a given control section and for directing a processing unit of the transcription system to carry out a function associated with the given control section.

In another embodiment, the kit includes a writing surface containing a background image. The kit also includes a computer readable medium including instructions which when performed by a processor to create the background image on a monitor. The computer readable medium also includes instructions for forming a composite image corresponding to a combination of the background image and the image written upon the writing surface. According to this embodiment, the writing surface may be a blank form, such as a spreadsheet. Using this kit, it is possible to take a blank form such as a spreadsheet and fill out the blank form on the writing surface while simultaneously recording the same blank form being filled out.

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control section, or electronically mailed when the stylus contacts a particular control section.

According to this kit embodiment, the one or more control sections may include control sections for performing calculator functions, the computer readable medium including logic for performing the calculator functions when the stylus contacts particular control sections.

According to this kit embodiment, the computer readable medium may include a data file identifying the positions of the control sections of the template.

According to this kit embodiment, the kit may include a plurality of different templates and the computer readable medium may include one or more data files for the plurality of different templates which identify positions of control sections on each template, the computer readable medium further including logic which allows a user to select which of the plurality of templates is going to be used.

According to this kit embodiment, the computer readable medium may include logic which allows a user to specify what function is performed by the transcription system in response to the stylus contacting a particular control section.

In another embodiment, a kit is provided for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving position signals transmitted from a stylus when the stylus is positioned adjacent the writing surface, the transcription system recording writing performed by the stylus on the writing surface. According to this embodiment, the kit comprises

a background image coupleable to the writing surface; and

a computer readable medium including

logic for detecting a position of the background image on the writing surface,

logic for detecting a position of the stylus relative to the background image on the writing surface,

logic for recording writing by the stylus relative to the background image, and

logic for forming a composite image comprising the background image and the writing by the stylus on the background image.

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Also according to this embodiment, the function associated with the input section may be modifying an image displayed on a monitor operatively connected to the transcription system, the transcription system modifying the image in response to determining that the stylus contacted the save input section. The function associated with the input section may also be saving an image displayed on a monitor operatively connected to the transcription system, the transcription system saving the image in response to determining that the stylus contacted the save input section. The function associated with the input section may also be erasing an image displayed on a monitor operatively connected to the transcription system, the transcription system erasing the image in response to determining that the stylus contacted the save input section. The function associated with the input section also may be changing a color of an image displayed on a monitor operatively connected to the transcription system, the transcription system changing the color of the image in response to determining that the stylus contacted the save input section.

Associated with this method is a computer readable medium including:

logic for taking a file encoding positions of one or more input sections on a pad to be positioned adjacent the writing surface and associating with the one or more input sections a function to be performed when the stylus is detected as having been positioned adjacent to one of the input sections;

logic for determining that the stylus has been positioned adjacent to a particular input section based on times of flight of position signals from the stylus adjacent the particular input section to the plurality of signal receivers; and

logic for causing the transcription system to perform the function associated with the input section in response to determining that the stylus has been positioned adjacent to the particular input section.

In one variation, the function associated with the input section may be modifying an image displayed on a monitor operatively connected to the transcription system, the logic for causing the transcription system to perform a function including logic for causing the transcription system to modify the image in response to determining that the stylus contacted the save input section.

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A method is also provided comprising:

activating a user activated control switch mounted on the writing surface;

producing as a result of activating the user activated control switch a control signal which is communicated to the transcription system; and

having the transcription system perform a function in response to receiving the control signal.

According to the method, activation of the control switch may cause at least a portion of an image displayed on a monitor operatively connected to the transcription system to be modified.

Also according to the method, activation of the control switch may cause at least a portion of an image displayed on a monitor operatively connected to the transcription system to be erased, saved, printed, electronically mailed or facsimiled.

In another embodiment, a method is provided which comprises positioning a background image adjacent the writing surface such that the background image can be seen by a user;

having the transcription system determine a position of the background image relative to the signal receivers;

having the user write adjacent the background image using the stylus such that the user sees a composite image comprising the background image and the writing;

having the transcription system detect the writing by detecting the position of the stylus; and

having the transcription system create an electronic equivalent of the composite image by combining the background image with the writing.

According to the method, the method may further comprise displaying the electronic equivalent of the composite image on a monitor operatively connected to the transcription system.

Also according to the method, positioning the background image adjacent the writing surface may include attaching a sheet of material including the background image adjacent the writing surface.

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in combination with any of the other methods of the present invention, According to these methods, temperature sensors may optionally be incorporated into the stylus, template and/or positioned adjacent one or more of the detectors.

A method is also provided for forming or modifying an image displayed on a monitor or projected on a surface by forming that image or modifying that image on a writing surface using a stylus and transcription system of the present invention. It is noted that modifying the image may include erasing a portion of the image on the writing surface which causes the erased portion to be removed from the monitor or projected image.

A variety of calibration methods are provided. In one embodiment, the calibration method comprises:

attaching the plurality of signal receivers to the writing surface at unknown distances from one another, each signal receiver including a calibration mark at a known position relative to the signal receiver;

transmitting position signals from each calibration mark; and

using times of flight of the position signals to determine separation distances between the plurality of signal receivers.

According to this embodiment, the position signals may be transmitted from a stylus by contacting the stylus to the calibration marks.

In another embodiment, a method is provided which comprises:

positioning a pad adjacent the writing surface, the pad including a plurality of calibration marks;

positioning the stylus adjacent to each calibration mark, the stylus transmitting a position signal to the signal receivers in response;

having the transcription system determine separations between the signal receivers based on times of flight between the calibration mark and the signal receivers.

According to this embodiment, two calibration marks and two signal receivers may be utilized to perform the method.

In another embodiment, the method comprises:

attaching a template to the writing surface, the template having two or more calibration marks at known separation distances from one another;

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medium further including logic for determining the position of the one or more control sections relative to the signal receivers.

Also according to this embodiment, the template may include a mouse region which serves as a virtual touch pad for the user. In this regard, the user can move the stylus within the mouse region and cause a cursor associated with the system to move. Thus, by moving the stylus within the mouse region, the stylus can serve as a mouse for the system. In this embodiment, the system includes logic for utilizing the movement of the stylus within the system as a mouse.

Also according to this embodiment, the template may include a graffiti region which can recognize handwritten signals, such as handwriting graffiti used with the PALM PILOT. In this embodiment, the system includes logic for utilizing the movement of the stylus within the graffiti region and translating that movement into handwritten signals.

In another embodiment, the computer readable medium includes

logic for taking times of flight of position signals from calibration marks to signal receivers and using the times of flight to determine separation distances between the signal receivers.

It is noted in regard to methods of the present invention that these methods employ logic and a processor for executing the logic. The logic may be software or firmware and may be stored in any form of computer-readable medium including diskettes, CDs, and hard drives. The logic may also be maintained on a server. The present invention is intended to encompass any device which includes logic for performing any method according to the present invention. The present invention is also intended to encompass any form of computer-readable medium which includes logic for performing any method according to the present invention.

Each of the above methods is preferably performed by a processor. Accordingly, an aspect of the present invention relates to a computer-readable medium, such as a diskette, CD, or hard drive which including instructions to be carried out by a processor for performing the various methods of the present invention. The present invention also relates to a computer, PDA, server, and the like which incorporates logic for performing the various methods of the present invention.

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Figure 3C illustrates a transcription system where a first detector includes a calibration mark for calibrating the transcription system.

Figure 3D illustrates a detector assembly where a first and second detectors are separated by a coupling member.

Figure 3E illustrates a detector assembly where a first and second detectors are positioned along a side of the writing area.

Figure 4A is a side view of a stylus which may be used in a transcription system according to the present invention.

Figure 4B is a side view of a stylus including a removable cap.

Figure 4C is a disassembled side view of a stylus including a stylus housing, a door and a stylus.

Figure 4D is a side view of the stylus illustrated in Figure 4C assembled.

Figure 4E is a side view of a stylus coupled to a transcription system by an electrical wire for providing a reference signal to the stylus.

Figure 4F is a side view of a cap according to the present invention.

Figure 4G is a side view of a stylus with a cap in place.

Figure 4H is a cross section of a stylus coupled with a cap adapted to accommodate a position signal transmitter or receiver.

Figure 4I is a cross section of a stylus coupled with a cap adapted to accommodate a position signal transmitter or receiver.

Figure 4J is a cross section of a stylus with a ridge coupled with a cap a cap adapted to accommodate a position signal transmitter or receiver.

Figure 4K illustrates a stylus embodiment where the stylus electronics are positioned toward a distal end of the stylus adjacent the tip.

Figure 4L illustrates a stylus embodiment where an elongated writing element is employed which allows the diameter of the stylus to be further reduced.

Figure 5A is a side view of an eraser for use with a transcription system.

Figure 5B is a bottom view of the eraser illustrated in Figure 5A.

Figure 6A is a side view of a detector.

Figure 6B is a bottom view of a detector.

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Figure 8A illustrates a block diagram which can be used with the system illustrated in Figure 2A.

Figure 8B illustrates a block diagram which can be used with the system illustrated in Figure 2C.

Figure 8C illustrates a block diagram which can be used with the system illustrated in Figure 2D.

Figure 9 is a circuit for triggering transmission of a position signal in response to receiving a reference signal.

Figure 10 is a circuit which can be used to detect when a position signal has been received at a detector.

Figure 11A illustrates dimensions of writing area and monitor image area.

Figure 11B illustrates coordinate systems transposed on the writing area and the monitor image area when the first and second detectors are position along the top of the writing area.

Figure 11C illustrates coordinate systems transposed on the writing area and the monitor image area when the first and second detectors are position along a side of the writing area.

Figure 11D illustrates creation of a monitor image.

Figure 12 is a block diagram of a processing unit.

Figure 13 illustrates an image data structure used to store a series of stylus positions.

Figure 14 is a implement characteristic data structure used to identify whether an implement is an eraser or a stylus and to identify the characteristics of each stylus.

Figure 15A is an control section relative to template data structure.

Figure 15B is an control section relative to detectors data structure.

Figure 16A is a process flow of a calibration module.

Figure 16B is a process flow for determining the dimensions of a writing area in a transcription system as illustrated in Figure 3B.

Figure 17 is a process flow for determining the positions of the stylus relative to the detectors and creating the monitor image from the determined positions.

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Figure 27E(2-4) illustrate a sequence of images displayed on a user interface to allow the transcription to determine the position of the template relative to the detector assembly on the writing surface

Figure 28A illustrates a window which allows the user to configure the writing surface.

Figure 28B illustrates a window which allows the user to configure the stylus.

DETAILED DESCRIPTION

Transcription System Overview:

The present invention relates to a system for recording writing performed on a surface and its components and related methods where the position of a stylus used in the system to write on the surface is tracked using signals. Writing is intended to include the formation or modification of any type of image on a surface by a writing element, including printing, drawing, sketching, erasing and the like. The surface on which the writing is performed may be any surface on which writing may be performed. Examples of suitable surfaces include but are not limited to, whiteboards, blackboards, clipboards, desktops, walls, projection screens, flip chart tablets, and glass panes whether or not covered by a material such as paper, glass, metal, or plastic which can be written upon. The surface is preferably a relatively smooth and relatively flat surface, although it is noted that the surface may have a degree of curvature.

In a system according to the present invention, a stylus including a housing and a writing element is provided. The writing element may optionally be removable from the housing. In one embodiment, the writing element is removed from an end of the housing while in another embodiment the writing element is removable from a side of the stylus housing. Also provided are two or more detectors which may be permanently or removably affixed to a writing surface and are used in combination with the stylus to detect the position of the stylus on the writing surface. Also provided in the system is hardware for controlling when reference and position signals, described herein, are sent between the stylus and the two or more detectors.

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Figure 1B illustrates how the transcription system illustrated in Figure 1A may be installed relative to a writing surface 28. The first detector 12A and the second detector 12B are removably coupled to the writing surface 28. As illustrated by the arrows 30, the first detector 12A and second detector 12B can be placed anywhere on the writing surface 28. However, it is generally preferred that the first detector 12A and the second detector 12B be positioned adjacent an edge of the writing surface 28. It is also noted that the first detector 12A and the second detector 12B may optionally be permanently attached to the writing surface 28.

As illustrated in Figures 1A and 1B, a template 18 positioned on or adjacent to the writing surface can be used to control the transcription system using a stylus adjacent the writing surface. As illustrated, the template 18 includes markings which define the perimeter of several control sections 32. The control sections on the template 18 can be used to initiate functions which are carried out by the hardware unit 14 and/or the processing unit 20. An advantage of the template is that it allows the user to control the monitor image 34 and the transcription system through the template as opposed to the user interface 24.

Examples of functions that can be associated with a control section include, but are not limited to, causing the current monitor image 34 to be saved; causing the current monitor image 34 to be saved and moved to the background while a new monitor image area 36 is brought to the foreground for the creation of a new monitor image 34; causing the current monitor image 34 to be moved to the background while a new monitor image area 36 is brought to the foreground for the creation of a new monitor image 34; causing a copy of the current monitor image to be saved in the background while the current monitor image remains in the foreground for any additional adjustments; causing the entire monitor image 34 to be erased while retaining the current monitor image area 36 in the foreground; bringing a new monitor image area 36 into the foreground; maximizing the size of the current monitor image area 36 to fill the available space on the monitor; bringing the last monitor image area 36 to the foreground when another program was last used in the foreground; initiating calibration or recalibration of the transcription system; enabling or disabling selected functions; changing or selecting the color of particular strokes on the monitor image 34 or changing the particular color correlated with a

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writing portion of the stylus within a different section 32 can cause POWER POINT to move to the previous slide or display. As a result, a user can scroll through the slides of a presentation and capture any notes the user makes on a writing surface 28 during the presentation. In this regard, the template can also function as a remote control or mouse for the system for various computer applications.

As can be seen from the above illustrative list of how a template can be used, a wide variety of additional system functions can be envisioned and are intended to fall within the scope of the present invention. The various control sections of the template can be defined with different colored sections of the template 18 or outlined sections of the template 18.

Templates used with the system can be selected from a series of different templates stored into memory which are recognized by the transcription system. In use, the system is instructed as to which template has been selected. Optionally, the template may be selected by printing the template out from memory. Once selected, the template is placed adjacent the writing surface.

Templates may also be user defined. In one variation, a template is user defined within a program employed with the system. The user defined template is then printed out and the system is instructed that template will be used. In another variation, a template is user defined by drawing the template on the writing surface in combination with instructing a program employed with the system that the template being drawn is to be used. Predetermined control signal images, in combination with handwriting recognition can be used to assist the system in reading the template into memory that is drawn on the writing surface.

The template 18 can be constructed from any material suitable for attaching to a flat surface such as a piece of paper on which a template has been printed and a thin plastic sheet which can attach itself to the writing surface 28 via static cling. A feature of the present invention is that the template may be devoid of electronic circuitry and need not receive or transmit any signals.

When a template is employed, the template is preferably positioned at a distance from the first detector and the second detector. For example, in Figure 1A the template 18 is illustrated as being positioned on an opposite side of a writing area 38 relative to

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10 with the calibration mark 40 on the template 18 as illustrated. In another embodiment, the processing unit 20 can create an image of a stylus contacting a calibration mark 40 on an image of a detector. In response, the user contacts a calibration mark 40 on the first detector 12A. The transcription system will be calibrated after the user follows each prompt provided by the processing unit 20. Because the transcription system is easily calibrated by the user, the transcription system is readily usable with different sized writing surfaces 28.

After the transcription system has been calibrated, the system is generally ready for use. As illustrated in Figure 1D, the user can write in the writing area 38 with the stylus 10. While the user is creating an image in the writing area 38, a similar image appears in a monitor image area 36 of the monitor 22. The image in the writing area 38 is referred to as the written image 44 and the image on the monitor 22 is referred to as the monitor image 34. As illustrated in Figure 1E, the written image 44 can also be erased using an eraser 16. The monitor image 34 is erased as the written image 44 is erased using the eraser 16.

Optionally, the system is periodically recalibrated during operation to account for temperature changes adjacent the writing surface. Changes in temperature can occur, for example, due to a change in whether sunlight is impacting upon the writing surface (e.g., opening or closing blinds, passage of time). These temperature changes can alter the speed at which position signals travel. Measurement of temperature can be used to detect these temperature changes and recalibrate the system accordingly. In one variation, a method is providing for correcting for the effect of temperature on the speed of ultrasound signals in the transcription system comprising measuring a temperature adjacent a writing surface where an ultrasound transcription system is being employed; and adjusting time of flight calculations using the measured temperature adjacent the writing surface. This method may be employed in combination with any other calibration method.

The monitor image 34 can be stored for later editing and manipulation or can be converted to a number of electronic and digital document formats including, but not limited to, fax, e-mail, word processing programs such as WORD and WORDPERFECT, graphic presentation and preparation programs such as POWERPOINT, VISIO and

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number 2 to appear in the display 48. Further, if the user interface includes a mouse or other cursor control device, the cursor can be aligned with the keys illustrated on the calculator image 46. Clicking the mouse while the cursor is aligned with a particular key causes the function associated with that key to occur.

The calculator image 46 can include keys which do not correspond to any of the control sections 32 on the template 18. These keys can perform functions which are not performed by positioning the stylus within any of the control sections on the template 18. As described, the keys can be activated with a typical user interface.

The calculator image 46 need not always be visible to the user. For instance, the calculator image 46 can be manually called up onto the monitor 22 by positioning the stylus in the function control section 32 labeled "ON/C". The calculator image 46 can also be automatically called up on the monitor 22 when the stylus is positioned in control sections 32 corresponding to the calculator functions other than the functional control section 32 labeled "OFF". The calculator image 46 can be automatically withdrawn from the monitor 22 after a pre-determined period of time has elapsed. The calculator image 46 can also be manually withdrawn from the monitor 22 by positioning the stylus in the function control section 32 labeled "OFF".

When the calculator image 46 is called up, the calculator image 46 can replace the monitor image area 36 on the monitor 22 or can appear over the monitor image area 36 as illustrated in Figure 1F. When the calculator image 46 appears over the monitor image area 36, the user can switch between the monitor image area 36 and the calculator image 46 by using a user interface 24 such as a mouse to position a cursor on the calculator image 46 or the monitor image area 36. As is known in Windows technology, when the cursor is positioned on the calculator image 46, the calculator image 46 will be moved to the front so it is in full view. Similarly, when the cursor is positioned on the monitor image area 36, the monitor image area 36 will be moved to the front so it is in full view.

It is noted that the image being formed on the writing surface may be simultaneously projected onto the same or a different surface, for example on an adjacent projectable surface, onto the writing surface (front or rear projection) or in a remote location. In this regard, the use of the template as a calculator as described above also

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Figure 1G also illustrates the control sections 32 including icons or text which indicate to the user the function that will be performed by positioning the writing portion of the stylus within the perimeter of one of the control sections. Although the previously illustrated calibration marks are illustrated as being positioned along one edge of the template 18, the calibration marks can be positioned anywhere on a template. Preferably, the calibration marks 40 are positioned with a maximum displacement between the calibration marks. As a result, the calibration marks can be positioned in opposing corners of the template 18 as illustrated in Figure 1G.

As illustrated in Figure 1H, the writing surface 28 can also include a background image 50 which is either printed onto the writing surface or positioned over the writing surface. Alternatively, the background image 50 can be projected onto the writing surface. Since the writing surface can be constructed from transparent materials such as glass or plastic, the background image 50 can be projected onto the surface from either behind or in front of the writing surface. Suitable forms for the background image 50 include, but are not limited to, a spreadsheet as illustrated in Figure 1H, blueprints, handwritten or typewritten text, notes, graphs, graphics, etc.. The background image 50 can be placed on a material which is physically attached to surface and used as the writing surface. Examples of materials on which a background image 50 may appear include paper, plastic sheets and other materials which can be written upon. The background image 50 can also be an image which is projected onto a writing surface 28. For instance, the background image 50 can be an image projected onto the writing surface 28 from a front or rear projection system (e.g., a reflective or transmissive display).

As illustrated in Figure 1H, when a background image 50 is used on the writing surface 28, writing on the writing surface in combination with the background image 50 forms a composite image 52 which appears on the monitor 22. The system can be calibrated so strokes written on the writing surface 28 are properly positioned relative to the background image 50 in the composite image 52 that is formed. For instance, when the background image 50 includes an image of a spreadsheet, an image written into a particular cell of the background image 50 appears in the same cells on the composite image 52 as illustrated in Figure 1H.

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background image by writing on the writing surface 28, thereby forming a composite image comprising the projected background image 50 and the writing 54. The composite image 52 of the projected background image 50 and the writing made on the writing surface can be displayed on a monitor 22, stored into memory, and/or projected in another location. As can be seen from this embodiment, a variety of composite images can be formed which allow for a dynamic range of graphic presentations to one or more remote locations.

System Variations:

In general, the transcription system records the written image 44 by detecting the position of the stylus 10 on the writing surface 28 at multiple times, each position detected serving to form a point on the monitor image 34. By detecting the position of the stylus 10 at a sampling rate that is fast relative to the speed with which the stylus 10 is moved during writing, an image 34 corresponding to what has been written can be recorded and displayed in real time. As will be described in detail below, each point is determined based on the time that it takes for a position signal to travel between the stylus 10 and the first and second detectors 12A, 12B. This time is called the position signal's time of flight.

Several different system designs may be employed in order to determine a position signal's time of flight between the stylus 10 and the first and second detectors 12A, 12B. Several of these different system designs are described with regard to Figures 2A-2D. It is noted however that additional system configurations may also be envisioned and are intended to fall within the scope of the present invention.

Figure 2A illustrates an embodiment where the stylus 10 includes at least one reference signal receiver 56 and a position signal transmitter 58. Meanwhile, the first detector 12A and the second detector 12B each include a position signal receiver 60. Located somewhere in the system is a reference signal transmitter 62. In Figure 2A, the reference signal transmitter 62 is included in the second detector 12B. In other embodiments, the reference signal transmitter 62 can be included in the hardware unit 14.

As illustrated in Figure 2A, a reference signal 64 is transmitted to the stylus 10. Receipt of the reference signal 64 by the stylus 10 triggers the stylus 10 to transmit a

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Figure 2B illustrates an alternative embodiment where the stylus 10 includes a position signal transmitter 58 and is physically attached to the hardware unit 14 by a wire 68. Meanwhile, the first detector 12A and the second detector 12B each include a position signal receiver 60.

As illustrated in Figure 2B, a reference signal 64 is transmitted to the stylus 10 from the hardware unit 14 via the wire 68. When the reference signal 64 is received, the stylus 10 transmits a position signal 66 which propagates radially from the stylus 10 and is received by the first detector 12A and the second detector 12B at a time that is dependent on the distance between the stylus 10 and the first detector 12A and the second detector 12B at the time that the position signal 66 is produced. Since the position signal 66 is transmitted at a known time after the reference signal 64 is transmitted, the time of flight of the position signal 66 to the first and second detectors 12A, 12B can be determined.

Figure 2C illustrates an alternative embodiment where the stylus 10 includes a position signal transmitter 58 and the first detector 12A and the second detector 12B each include position signal receivers 60. The stylus 10 also includes a reference signal transmitter 62 and the second detector 12B includes a reference signal receiver 56 in addition to the position signal receiver 60.

As illustrated in Figure 2C, a reference signal 64 is transmitted by the stylus 10 to the second detector 12B to signal that a position signal 66 is being transmitted or is about to be transmitted. The position signal 66 is received by the first detector 12A and the second detector 12B. Since the position signal 66 is transmitted at a known time after the reference signal 64 is transmitted, the time of flight of the position signal 66 to the first and second detectors 12A, 12B can be determined by the processing unit 20.

In the embodiment illustrated in Figure 2C, the reference signal 64 and the position signal 66 can be transmitted together for each point in the monitor image 34. However, the position signal 66 can also be transmitted without the reference signal 64. For instance, the reference signal 64 can serve to synchronize the timing of the stylus 10 and the hardware housing and/or the processing unit 20. When the reference signal 64 serves as a synchronizing signal, the stylus 10 is configured to transmit a series of position signals 66 at a known time interval. The reference signal 64 indicates when the

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of the dimensions which can be determined during calibration. Each of these dimensions are illustrated in Figure 3A. The position of the template 18 and each of the control sections 32 can also be determined during the calibration of the system. Different embodiments of the transcription system require that different combinations of these variables or none of these variables be determined during calibration.

Figure 3B illustrates an embodiment which can automatically determine the first and second detector displacement, L. The first detector 12A includes a reference signal receiver 56 and a position signal transceiver 70. Examples of suitable position signal transceivers 70 include, but are not limited to, PZT, PVDF, electrostatic and piezoelectric or piezoceramic ultrasonic transceivers.

During calibration of the system, a reference signal 64 transmitted from a reference signal transmitter 62 included in the second detector 12B is received at the reference signal receiver 56 included in the first detector 12A. In response, a position signal 66 is transmitted from the position signal transceiver 70 in the first detector 12A. The position signal 66 is received by the position signal receiver 60 of the second detector 12B. The time of flight of the position signal 66 between the first and second detectors 12A, 12B can be multiplied by the speed of sound to determine L. When the system is not being calibrated, the position signal transceiver 70 works as a position signal receiver 60. In another embodiment, the position signal transceiver 70 can be replaced with a position signal transmitter 58 and an independent position signal receiver 60.

Figure 3C illustrates another embodiment including features for system calibration. The first detector 12A includes a calibration mark 40. During calibration, the user is prompted by the computer to contact the stylus 10 within the calibration mark 40. Upon contact of the stylus 10 with the calibration mark 40, the stylus transmits a position signal 66. The position signal 66 is received at the position signal receiver 60 included in the second detector 12B. The time of flight of the position signal 66 between the first and second detectors 12A, 12B is multiplied by the speed of sound to determine the first and second detector displacement, L.

As discussed above, the processing unit 20 may optionally produce an image on the monitor 22 to guide the user through the calibration. For instance, the processing unit

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this type of calibration periodically, changes in temperature conditions, for example due to whether sunlight is impacting upon the writing surface, can be addressed.

The Stylus:

One or more styluses may be used with the transcription system. Figure 4A illustrates an embodiment of a stylus 10 which can be used with the transcription system illustrated in Figure 2A. As illustrated, the stylus 10 includes a stylus housing 76 and a writing element 78. Examples of suitable writing elements 78 include, but are not limited to, an inkwell, chalk, pencil, pencil lead, pen and a marker such as a SANFORD EXPO. The stylus housing 76 includes a tip end 80 with a position signal transmitter 58 adjacent the end. The stylus housing 76 as illustrated also includes activation electronics 82, implement electronics 104, and a plurality of reference signal receivers 56. The stylus housing 76 is also capable of housing a power source 84 which is preferably removably attachable to the stylus.

In Figures 2A, 2C and 2D, the reference signal transmitters 62 or reference signal receivers 56 are illustrated as being positioned at an upper end of the stylus, however, the reference signal transmitters 62 or reference signal receivers 56 can be positioned at the tip end 80 of the stylus 10 as illustrated in Figure 4A. Reference signal transmitters 62 or reference signal receivers 56 can also be included as a ring of piezoelectric material 86 extending around the circumference of the stylus 10. The ring of material can be constructed from any material known to transmit the reference signal.

As illustrated in Figure 4B, the stylus housing 76 may be designed such that the writing element 78 is removable from the stylus housing 76. As illustrated, the stylus housing 76 may include a removable member 88 which is attachable and detachable to an end of a sleeve 90. As illustrated, sleeve 90 defines a volume 92 within which the writing element 78 may be positioned and the removable member 88 serves to maintain the writing element 78 within the sleeve 90. When the writing instrument is replaced, the tip 94 of the replacement writing instrument is inserted through the stylus housing 76 and into the tip end 80 of the stylus 10. The removable member 88 is placed on the stylus 10 so the rear 96 of the writing instrument is in contact with the activation electronics 82.

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signal or a position signal. Upon detecting the low media signal the hardware unit can activate a particular indicator or can provide a second low media signal to the processing unit which can respond accordingly.

It is preferred that at least a portion of the stylus housing 76 is clear or opaque such that it is possible to see the writing element 78 within the housing. This allows the user to observe the color of the writing element 78 without having to open the housing or remove the writing element 78. In certain instances, for example when chalk, graphite or a liquid ink reservoir is used in conjunction with the writing element, it is possible to observe how much writing media is remaining.

The activation electronics 82 can include a contact switch which indicates when the stylus 10 is being used to write. The contact witch typically works based on pressure being exerted between the stylus 10 and a writing surface 28. In operation, the stylus 10 is held such that the tip 94 of the writing instrument is contacted with the writing surface 28. The pressure of the writing instrument on the writing surface 28 closes the contact switch to activate a circuit within the implement electronics 104.

When the circuit within the stylus housing 76 is activated, an activation signal is provided to the system to indicate that the stylus 10 has been contacted with the writing surface 28. The propagation of reference and position signals 66 can be initiated in response to the activation signal. The activation signal may be a position signal 66 or a reference signal 64 transmitted from the stylus 10. Similarly, when the implement electronics 104 is deactivated by lifting the stylus 10 off the writing surface 28, a deactivation signal may be transmitted to the system. The system can also detect when the implement electronics 104 has been deactivated by detecting that a position signal 66, or reference signal 64, has not been transmitted from the stylus 10 for some predetermined period of time.

The activation electronics 82 can optionally include a pressure sensor which measures the pressure exerted between the stylus 10 and the writing surface 28 called the exerted pressure. Examples of pressure sensors which may be used include, but are not limited to strain sensors, piezoelectric elements or linear resistive strips. The activation electronics 82 can produce a signal indicating the exerted pressure. The signal can be received within the implement electronics 104 and can serve to activate the implement

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message on the monitor 22 or by an indicator on the hardware unit 14. An example of an indicator (not shown) on the hardware unit 14 may be an LED which flashes once the power signal has been received.

The implement electronics 104 can also include logic for producing an identifier signal which is unique to the type of the stylus 10 being used. The identity signal can be encoded into a reference signal 64 or a position signal 66 transmitted from the stylus 10. The hardware unit 14 or the processing unit 20 can include logic which can identify the identity signal and interpret the identity signal to determine the type and accordingly the characteristics of the stylus 10 from the identity signal. The characteristics of the stylus can include color, line, width, and line pattern.

The identifier signal can be transmitted when the implement electronics 104 are first activated or each stylus 10 can constantly transmit signals which are unique to that particular type of stylus 10. The identifier signal can be received within the hardware unit 14 or the processing unit 20 and used to identify the particular stylus 10 being used to write upon the writing area 38. Once the stylus 10 has been identified, the monitor image 34 is created with characteristics which correlate to the identified stylus 10. For instance, the stroke on the monitor image 34 can have a color matching the color of the stylus 10 being used to write on the writing surface 28 can have a stroke width matched to the width of the stylus 10.

When the stylus transmits an identifier signal which is identified with a particular color, the stylus housing 76 can include a visible identifier which indicates to a user the color of the strokes which will appear on the monitor image 34 when that stylus 10 is used. For instance, the stylus housing can be 50% transparent and 50% red in color to indicate that use of the stylus will cause red colored strokes to appear on the monitor. Of course, the transcription system can include logic for changing the color of a stroke on the monitor after the stroke has been made.

When the stylus transmits an identifier signal which is identified with a particular characteristics, the stylus housing 76 can be designed so it will accept only writing implements with the particular characteristics. For instance, if a stylus housing transmits an identity signal which is identified with the color red, the stylus housing and writing implements can be designed so the stylus housing will not accept writing implements

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Figure 4C illustrates an embodiment of the stylus 10 which can be used with the transcription system illustrated in Figure 2B. The implement electronics 104 is coupled to the system via an electrical wire 68. As a result, the reference signal 64 can be transmitted to the stylus 10 via the wire 68. The position signal 66 is transmitted from the position signal transmitter 58 in response to receiving the reference signal 64.

The stylus 10 can also be adapted to be used in a transcription system such as the one illustrated in Figure 2C. For example, the stylus 10 can include a reference signal transmitter 62 and a position signal transmitter 58. The detectors 12A, 12B can be modified to include a reference signal receiver 56 and a position signal receiver 60.

The stylus 10 can also be adapted to be used in a transcription system such as the one illustrated in Figure 2D. For example, the stylus 10 can include a reference signal transmitter 62 and a position signal receiver 60. The detectors 12A, 12B can be modified to include a position signal transmitter 58. A reference signal receiver 56 is also provided in the system and may optionally be incorporated into one of the detectors 12A, 12B.

The stylus can include a cap for covering a portion of the writing element which extends outside of an end of the stylus housing and is used to write upon a writing surface. The cap may optionally be clear in order to allow the user to observe the color of the writing element without having to remove the cap. The cap may also optionally be sized to fit over a position signal transmitter or position signal receiver positioned adjacent an end of the stylus housing out of which the writing element extends. The stylus housing may optionally include a cap holding mechanism to which the cap may be attached when the stylus is in use.

An example of a stylus cap is illustrated in Figure 4D. The cap 106 is configured to be coupled with the stylus 10 as illustrated in Figures 4C and 4E. The cap 106 can also configured to be coupled with a back end the stylus as illustrated in Figure 4D. Accordingly, during operation of the stylus, the cap 106 can be stored on the back of the stylus in order to prevent loss of the cap 106. The cap 106 can serve to protect the tip of the stylus 10 or the writing element 78 when the stylus 10 is not in use. The cap can also serve to prevent certain types of writing elements 78, such as markers, from drying out from exposure to air.

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applied to the cap 106, the cap 106 deforms enough for the cap ridge 114 to slide past the stylus ridge 116. In this position, pressure is also required to remove the cap 106 from the stylus 10. As a result, the cap 106 remains in place on the stylus 10 until the user applies the pressure necessary to remove the cap 106.

The above cap embodiments are advantageous because traditional cap designs frequently rely on friction between the stylus neck 118 and the cap 106 to keep the cap 106 in place. However, such a cap design could damage a position signal transmitter 58 positioned on the stylus neck 118. Further, traditional caps do not include the volume required to accommodate the position signal transmitter 58.

Figures 4K and 4L illustrate further alternative embodiments of styluses that may be used with the system of the present invention. These styluses are designed to be used with a removable, disposable writing element which includes its own power source for powering the operation of the stylus. These embodiments obviate the need for a separate power source 84 and a separate space in the stylus housing for a power source 85, as shown in Figure 4C. This allows the stylus design to be made smaller and more ergonomic. In particular, as can be seen in Figures 4K and 4L, the styluses have a narrower design which allows the styluses to better approximate the size and feel of a standard whiteboard marker.

Figure 4K illustrates a stylus embodiment where the stylus electronics are positioned toward a distal end of the stylus adjacent the tip. As illustrated, the stylus includes a housing comprised of a proximal body 111, a distal body 113. A removable, disposable writing element 115 is sized to fit within the stylus housing. The writing element 115 includes a power source 117 and power source contacts 119.

Included on the proximal body 111 is an exterior pen housing 121 which is preferably clear to show the color of the writing element being used. Also included on the proximal body 111 is a groove 123 for holding the stylus cap. Power source contacts and electrical traces (not shown) are also included in the proximal body 111 for delivering power from the power source 117 on the writing element 115 to electronics on the distal housing body 113.

Included on the distal body 113 is a piercing element 125 for delivering writing media from the writing element 115 to a stylus tip 127. It is noted that the distal body

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board eraser material. As a result, contact between the eraser pad 122 and the writing surface 28 can serve to erase a portion of the writing image from the writing area 38.

The activation electronics 82 on the eraser 16 can include a contact switch. The pressure of the eraser pad 122 on the writing surface 28 drives the eraser pad 122 against the contact switch closing the contact switch and activating a circuit within the implement electronics 104. Activating the implement electronics 104 can serve to signal the eraser's 16 operation to the hardware unit 14 and/or the processing unit 20 in a similar manner as discussed with respect to the stylus 10.

When the implement electronics 104 are activated, a reference signal 64 received at one of the reference signal receivers 56 triggers a position signal 66 to be transmitted from the position signal transmitter 58. The reference signal receivers 56 are preferably evenly spaced around the eraser 16 so a reference signal 64 can be received from different angles around the eraser 16. The reference signal receivers 56 and the position signal transmitter 58 can be similar to the reference signal receivers 56 and the position signal transmitter 58 used in the stylus 10.

The signal transmitted by the position signal transmitter 58 on the eraser 16 can optionally be different from the signal transmitted by the position signal transmitter 58 on the stylus 10. The hardware unit 14 and/or the processing unit 20 can then distinguish that the signal being received is from the eraser 16 as opposed to the stylus 10. When the transcription system detects that it is receiving signals from the eraser 16, the transcription system erases the monitor image 34 according to the position of the eraser 16 on the writing surface 28.

The processing unit 20 detects the position of the position signal transmitter 58 on the eraser 16. However, the portion of the written image 44 which is erased is the portion of the written image 44 in contact with any portion of the eraser pad 122 and not simply the position of the position signal transmitter 58. Accordingly, the processing unit 20 includes logic which accounts for the portion of the written image 44 actually contacted by the eraser pad 122. The processing unit 20 can be used to calculate an approximate eraser area 124 which matches the eraser pad footprint 126 as illustrated in Figure 5B. As the eraser 16 is moved about the writing surface 28, the portion of the monitor image 34 which falls within the approximate eraser area 124 is erased from the

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As illustrated in Figure 6B, a lower surface 134 of the detector housing 128 includes one or more attachment mechanisms 136 for removably attaching the detector housing 128 to the writing surface 28. Examples of suitable attachments mechanisms include, but are not limited to, suction cups, magnets, VELCRO or a refreshable contact cement. It is also envisioned that mounting brackets may also be attached to the writing surface 28 which may obviate the need for an attachment mechanism.

The detector 12B can be converted to detector 12A for use with the system of Figure 2A by removing the reference signal transmitter 62. The detector 12B may also be adapted for use with the transcription system of Figure 2B by removing the reference signal transmitter 62.

The detector 12B may also be adapted for use with the transcription system of Figure 2C by replacing the reference signal transmitter 62 with a reference signal receiver 56. Examples of reference signal receivers 56 that may be used include, but are not limited to, a photo diode.

The detector 12B may also be adapted for use with the transcription system of Figure 2D by replacing the reference signal transmitter 62 with a reference signal receiver 56 and by replacing the position signal receiver 60 with a position signal transmitter 58.

Figure 7A illustrates another embodiment of detectors 12A, 12B that may be employed. The first or second detector 12A, 12B includes a reflecting surface 138 attached to a frame 140. The reflecting surface 138 has a parabola shaped profile. The parabola is rotated 180 degrees about the parabola's focus to give the reflecting surface 138 a semi-circular footprint 142. The reflecting surface 138 can be constructed from any material which will reflect the position signal 66. In operation, the detectors 12A, 12B are positioned so the reflective surface extends into the writing area 38. The shape of the reflecting surface 138 provides the reflecting surface 138 with about a 180 degree reception range, i.e., the reflecting surface 138 will reflect positions signals 66 transmitted from a range of 180 degrees. As a result, the detectors 12A, 12B can be positioned at a corner of the writing area 38 or along an edge of the writing area 38.

Figure 7B is a side view of the detectors 12A, 12B illustrated in Figure 7A. A position signal receiver 60 positioned at the focal point of the parabola. An example of a

position signal receiver 60 that may be used is the L-series manufactured by Polaroid. The parabolic shape causes position signals 66 traveling at right angles to the frame 140 to be reflected into the position signal receiver 60. As a result, the reflecting surface 138 can serve to concentrate the position signals 66 and increases the opportunity for a position signal 66 to be received by the position signal receiver 60. A suitable height of the position signal receiver 60 above the writing surface 28 includes, but is not limited to, approximately 1.7 inches. A suitable radius for the footprint of the reflecting surface includes, but is not limited to, approximately 1.8 inches. A suitable equation for defining the shape of the parabola includes, but is not limited to, $y \approx 1.3x^2$.

The reflecting surface 138 can be designed to receive position signals 66 from varying angles. For instance, the reflecting surface 138 can have a parabola shaped profile which is rotated about 90 degrees about the parabola's focus as illustrated in Figure 7C. As a result, the reflecting surface has a 90 degree range of reception. The frame 140 can act as a filter by screening signals from outside the reception range and accordingly outside the writing area 38. A detectors 12A, 12B having a 90 degree range of reception can be positioned at a corner of the writing area 38.

Figure 7D illustrates a detector assembly 72 with the hardware unit 14 mounted on the coupling member 74. A cable 144 configured to be coupled with the processing unit 20 extends from the hardware unit 14. The cable 144 can be permanently coupled with the hardware unit 14 or can be removably coupled with the hardware unit 14 via a serial port. In operation, the coupling member 74 is attached to the writing surface 28 via the attachment mechanisms. The coupling member 74 can be attached along the top, bottom or side of the writing surface 28. Since the hardware unit 14 is positioned adjacent the writing surface 28, the reference signal transmitter 62 or the reference signal receiver 56 can be included on the hardware unit 14. Although the detectors 12A, 12B illustrated in Figure 7A are shown as the detectors of Figures 6A-6B, the detectors of Figures 7A-7C can be substituted.

Figures 7E and 7F illustrate a detector assembly 72 with a coupling member serving as the hardware unit 14 by housing the electronics performing the functions associated with the hardware unit 14. The attachment mechanisms 136, the first detector 12A and the second detector 12B can be removably coupled with the coupling member

74 or can be integral with the coupling member 74. The coupling member 74 can be constructed from a first member 146 and a second member 148. The first member 146 can be coupled to the second member 148 by a hinge 150 extending through a vertical side of the coupling member 74. As illustrated in Figure 7G, the hinge 150 permits the coupling member 74 to adopt two or more configurations. A distance between the first and second detectors can change in at least two of the configurations. As illustrated in Figures 7E and 7F, in one configuration, the detector assembly 72 adopts a configuration where the displacement between the detectors is known. As illustrated in Figure 7G, the detector assembly 72 can adopt a second configuration where the first and second detector are adjacent to one another. The second configuration can place the detector assembly 72 in a more compact form which is suitable for transporting the detector assembly 72.

To facilitate the formability of the detector assembly 72, the electronics can be positioned primarily within the first or second member 146, 148. Flexible wiring can pass through or in proximity of the hinge 150 to permit electrical communication between the first member 146 and the second member 148. For instance, the signals from the second detector 12B coupled with the second member 148 can be communicated with the electronics positioned primarily in the first member via flexible wires passing through the hinge 150 or in proximity to the hinge 150.

As illustrated in Figure 7H, the hinge 150 can also extend through a horizontal side of the coupling member 74. The detector assembly 72 can also include a third member 152 and a second hinge 154 as illustrated in Figure 7I. The first and second hinges 150, 154 permit the detector assembly 72 to adopt a first configuration and a second configuration.

The coupling member 74 can include releasable locking mechanisms for locking the coupling member 74 into the first or second configuration. The locking mechanism can be included in the hinge itself or on opposing portions of the first and second members 146, 148 which come into contact when the coupling member 74 is in a desired position. The hinge can also provide enough friction that the coupling member 74 remains in a particular position once the coupling member 74 is moved into the particular position.

As illustrated in Figure 7J, the detector assembly 72 can be capable of telescopic expansion where it includes a second member 148 which fits slidably within the first member 146. The slidability of the second member within the first member 146 permits the detector assembly 72 to adopt a first configuration and at least one second configuration. As illustrated in Figure 7K, the first member 146 includes a blocking structure 156 and a first flange 158 while the second member 148 includes a second flange 160. When the second member 148 is slid into the first member 146, the blocking structure 156 and the second flange 160 come into contact to limit the inward displacement of the second detector 12B. The second flange 160 contacting the blocking structure can indicate that the coupling member 74 is in a position suitable for transportation. When the second member 148 is withdrawn from the first detector 12A, the second flange 160 contacts the first flange 158 to prevent the second member 148 from being pulled out of the first member 146. The contact of the first flange 158 and the second flange 160 can indicate that the coupling member 74 is in a position suitable for operation of the transcription system.

The detector assembly 72 illustrated n Figures 7J and 7K can include a sensor system for automatically determining the displacement, L, between the detectors. For instance, the first or second members 146, 148 can include a resistive strip (not shown). The opposite member can include a contact which touches the resistive strip at different locations depending on the position of the first member 146 relative to the second member 148. The resistive strip and the contact can be in electrical communication with the hardware controller. The hardware controller can complete a circuit through the contact and the resistive strip. The resistance in the circuit varies depending on the position of the contact relative to the resistive strip. Since the position of the contact relative to the resistive strip depends on the position of the first member 146 relative to the second member 148, a relationship between the detector displacement, L, and the resistance in the circuit can be determined. By using this relationship, the displacement, L, between the detectors can be determined from the resistance in the circuit. As a result, the coupling member of Figures 7K and 7J can have a variable L which can be automatically determined and does not need to be calculated during calibration.

The coupling member 74 illustrated in Figures 7J and 7K can also include one or more releasable locking mechanisms. The one or more locking mechanisms can be used to lock the first and second members 146, 148 relative to one another once the user has moved them into a desired position.

As illustrated in Figures 7L, the detector assembly 72 can have a first configuration where the first and second detectors 12A, 12B are at a known displacement and a second configuration where the first and second members 146 and 148 are detached from one another. The first configuration can be formed by inserting a portion 162 of the first member 146 into an opening 164 in the second member 148. Conversely, the second configuration can be formed by withdrawing the portion 162 of the first member 146 from the second member 148. The detector assembly 72 can include a releasable locking mechanism which serves to retain the detector assembly 72 in the first configuration until the user chooses to detach the first member 146 from the second member 148.

Electrical communication between the first and second members 146, 148 can be achieved by including electrical leads on the first and second members 146, 148 which are positioned to be in contact with one another when the first and second members are attached to one another. Alternatively, a cable can be removably attached to the first and second members 146, 148. When the first and second members 146, 148 are detached, the cable can be detached from one or both of the first and second members 146, 148 in order to completely detach the first and second members 146, 148.

Figure 7M illustrates a user actuated attachment mechanism 136 which can be included with the coupling member 74. The attachment mechanism 136 includes a suction cup 166. A center 168 of the suction cup 166 is coupled with a member 170 extending through an opening 172 in the coupling member 74. The member 170 is movably coupled with a cam 174 included on an actuation lever 176.

In operation, the coupling member 74 is positioned so the suction cup 166 is in contact with the writing surface 28. Pressure is applied to the suction cup 166 to force air out from between the suction cup 166 and the writing surface 28. Forcing the air out causes a vacuum to be formed between the suction cup 166 and the writing surface 28. As illustrated, an end of the actuation lever 176 is then actuated so as to rotate the cam

174. The rotation of the cam 174 causes the center of the suction cup 166 to be pulled toward the coupling member 74. The coupling member 74 can include supports 178 which keep the coupling member 74 at a constant displacement from the writing surface 28. Since the coupling member 74 is at a constant distance from the writing surface 28, the motion of the center 168 of the suction cup 166 toward the coupling member 74 serves to increase the amount of vacuum between the suction cup 166 and the writing surface 28. As a result, the user actuated suction cups 166 can support a load exceeding the load which is supportable by normal suction cups. The increased load support ability provides sufficient support for a detector assembly 72 to be mounted to a vertical writing surface 28.

Although the above discussion describes the user actuated attachment mechanism 136 as being included on the coupling member 74, the attachment mechanism 136 can be included on a first and/or second detector 12A, 12B which stands independently or which is included in a detector assembly 72. Further, the number of user actuated attachment mechanisms 136 on a single detector and/or coupling member 74 can be increased until a detector or detector assembly is held firmly in place on a writing surface 28.

In Figure 7D, the detectors 12A, 12B are illustrated as having a 180 degree angular range of reception. However, is noted that the detectors 12A, 12B preferably have ranges of reception selected from the group of about 70 to 110 degrees, about 80 to 100 degrees, about 90 degrees, about 160 to 200, about 170 to 190 degrees, and about 180 degrees.

As illustrated in Figures 7A and 7C, the angular range of reception can be at least partially defined by a shielding element 118. The shielding element 118 is oriented relative to the position signal receiver 60 to shield the position signal receiver 60 from position signals transmitted by the stylus 10 when the stylus 10 is positioned outside a predetermined region 180. Figures 7N and 7O illustrate portions of a predetermined region 180 for detectors 12A, 12B with a range of reception of about 90 degrees and about 180 degrees respectively. In Figure 7N, the predetermined region 180 has an angular range of about 90 degrees extending outward from the detector parallel to the writing surface 28. In Figure 7O, the predetermined region 180 has an angular range of about 180 degrees extending outward from the detectors 12A, 12B parallel to the writing

surface 28. The predetermined region preferably has an angular range selected from the group including about 70 to 110 degrees, about 80 to 100 degrees, about 90 degrees, about 160 to 200, about 170 to 190 degrees, and about 180 degrees.

The detector assembly may include a plurality of control switches 182 and an indicator 184, as illustrated in Figures 7D, 7F and 7G. The user can activate each control switch 182 to control various functions which are performed by the processing unit 20 or the hardware unit 14. For example, activating a control switch can cause the current monitor image 34 to be saved; cause the current monitor image 34 to be saved and moved to the background while a new monitor image area 36 is brought to the foreground for the creation of a new monitor image 34; cause the current monitor image 34 to be moved to the background while a new monitor image area 36 is brought to the foreground for the creation of a new monitor image 34; cause a copy of the current monitor image to be saved in the background while the current monitor image remains in the foreground for any additional adjustments; cause the entire monitor image 34 to be erased while retaining the current monitor image area 36 in the foreground; bring a new monitor image area 36 into the foreground; maximize the current monitor image area 36 to fill the available space on the monitor; bring the last monitor image area 36 to the foreground when another program was last used in the foreground; notify the processing unit 20 that an overlay has been positioned on the writing surface; notify the processing unit 20 that an overlay has been removed form the writing surface; enable or disable selected functions; change or select the color of particular strokes on the monitor image 34; change the particular color correlated with a particular stylus 10; fax the monitor image 34; E-mail the monitor image 34; and/or print the monitor image 34. As discussed, certain embodiments of the transcription system require calibration, and activating a particular control switch can initiate calibration or recalibration. As discussed, the transcription system can be used simultaneously with other programs. Activating the control switches can serve to control the various functions of these other programs. For instance, actuating a particular control switch can cause POWER POINT to move to the next slide or display. Similarly, activating a different control switch 182 can cause POWER POINT to move to the previous slide or display. A wide variety of

additional system functions can be envisioned and are intended to fall within the scope of the present invention.

The indicators 184 can be used to indicate to the user a condition of the system. For instance, an indicator 184 can be an LED which flashes when a power source within the stylus 10 is running low in power, to acknowledge that a control switch 182 has been activated and/or to acknowledge that an error condition has occurred.

As illustrated in Figures 6A, 7B and 7C, the first and/or the second detector 12A, 12B can include a contact switch 186 coupled with the detector electronics 130. The contact switch is closed when the detectors 12A, 12B is positioned adjacent the writing surface 28 and is opened when the detectors 12A, 12B are removed from the writing surface 28. The detector electronics can include logic for identifying when the contact switch has gone from closed to open. In response, the detector electronics 130 can provide a re-calibrate signal which is received by the hardware unit 14. The hardware unit 14 includes logic for identifying the re-calibrate unit.

Electronics:

Figure 8A illustrates a block diagram for controlling the transmission and emission of the various reference signals 64 and position signals 66 and for determining the time for the first and second detectors 12A, 12B to receive a position signal 66. Various portions of block diagram are positioned in the first detector 12A, the second detector 12B, the hardware unit 14, the processing unit 20 and/or an implement 210 which can be either a stylus 10 or an eraser 16. For instance, the implement 210 includes a reference signal receiver 56 coupled with a trigger circuit 188 which is coupled with a position signal transmitter 58. The trigger circuit 188 triggers the transmission of a position signal 66 in response to receiving a reference signal 64. The first detector 12A includes a position signal receiver 60 coupled with a first detector circuit 190. The second detector 12B includes a reference signal transmitter 62 and a position signal receiver 60 coupled with a second detector circuit 192. The detector circuits provide a signal when the position signal receiver 60 has received a position signal 66.

The output from the first detector circuit stops a first timer 194 and asserts a first toggle within a toggle block 196. The output from the second detector circuit 192 stops a

second timer 198 and asserts a second toggle within the toggle block 196. The first timer 194, the second timer 198 and the toggle block 196 can be located within the hardware unit 14 and/or the processing unit 20.

The hardware unit 14 and/or the processing unit 20 includes a hardware controller 200. Examples of hardware controllers that can be used include, but are not limited to microsequencer, microcontroller or microprocessor. The hardware controller 200 periodically provides a DRV_XMIT signal on a DRV_XMIT line. The DRV_XMIT signal is received by the first timer 194, the second timer 198, the toggle block 196 and the reference signal transmitter 62 in the second detector 12B. The DRV_XMIT signal is also received by a timeout counter 202.

In operation, the hardware controller 200 provides a DRV_XMIT signal which causes the reference signal transmitter 62 to transmit a reference signal 64, resets the first and second timers 194, 198 and clears any toggles within the toggle block 196 which were previously asserted. The reference signal receiver 56 receives the reference signal 64. The trigger circuit 188 triggers the position signal transmitter 58 to transmit a position signal 66. The position signal receiver 60 within the first detector 12A receives the position signal 66 and the first detector circuit provides a signal indicating that a position signal 66 has been received. The signal from the first detector circuit stops the first timer 194 and asserts the first toggle in the toggle block 196. The position signal receiver 60 in the second detector 12B receives the position signal 66 and the second detector circuit 192 provides a signal indicating that a position signal 66 has been received. The signal from the second detector circuit 192 stops the second timer 198 and asserts the second toggle in the toggle block 196.

When the first and second toggles are asserted, an RCV_DONE? signal is received by the hardware controller 200. The hardware controller 200 sequentially activates the tri-state buffers 204. The data from the first timer 194 is received on a bus 206 via the tri-state buffers 204. The data from the second timer 198 is received on the bus 206 via the tri-state buffers 204. The processing unit 20 can receive information from the bus 206 via a UART 208. After the data from the first timer 194 and the second timer 198 is received on the bus 206, the DRV_XMIT signal is provided again.

When the time out counter reaches some pre-determined limit, called the timeout limit, before both toggles in the toggle block 196 are asserted, the DRV_XMIT signal is provided without the data on the first and second timers being received by the bus 206. As a result, if one of the detectors 12A, 12B misses a position signal 66, the next cycle of position detection is performed. The timeout limit can be administratively set to some value which is appropriate for most writing surfaces 28. The timeout limit can also be calculated by the processing unit 20 or the hardware controller 200. When the timeout limit is calculated, the timeout limit can be determined by dividing the writing area diagonal, D, by the speed of sound. The calculated timeout can be increased by some administratively determined factor. Whether the timeout limit is an administratively set value or a calculated value, it is conceivable that the transcription system can record the position of the implement when the implement is positioned outside the writing area 38 or off the writing surface 28.

Figure 8B illustrates another embodiment of a block diagram for controlling the transmission and emission of the various reference signals 64 and position signals 66. The block diagram is suitable for use with the system illustrated in Figure 2C. The implement 210 includes a reference signal transmitter 62 and the hardware unit 14 includes a reference signal receiver 56. The trigger circuit 188 in the implement 210 is designed so a reference signal 64 and a position signal 66 are regularly transmitted from the implement 210 with a period on the order of a typical administratively set timeout limit.

In operation, the reference signal 64 is received by the reference signal receiver 56. Receipt of the reference signal 64 causes the first timer 194 and the second timer 198 to be cleared. The position signal 66 is received by the first and second detectors 12A, 12B, stopping the first and second timers 194, 198 and asserting the first and second toggles within the toggle block 196. When the first and second toggles are asserted, an RCV_DONE? signal is received by the hardware controller 200. The hardware controller 200 sequentially activates the tri-state buffers 204 to deliver the data from the first and second timers 194, 198 to the bus 206. Since the reference signal 64 and the position signal 66 are periodically transmitted, the above sequence is repeated when the hardware unit 14 receives another reference signal 64 from the implement 210.

Figure 8C illustrates another embodiment of a block diagram which can be used with the system illustrated in Figure 2C. The implement 210 includes a reference signal transmitter 62 and the hardware unit 14 includes a reference signal receiver 56. The trigger circuit 188 in the implement 210 is designed so for each reference signal 64 transmitted from the implement 210, a plurality of position signals 66 are regularly transmitted from the implement 210 with a period on the order of the timeout limit.

In operation, upon activation of the implement electronics by placing the implement 210 in contact with the writing area 38, a reference signal 64 is transmitted from the implement 210 along with a position signal 66. The reference signal 64 is received by the reference signal receiver 56. In response to receiving the reference signal 64, the hardware controller 200 provides an DRV_XMIT signal which clears the first timer 194, the second timer 198 and the timeout counter 202. The position signal 66 is received by the position signal receivers 60, stopping the first and second timers 194, 198 and asserting the first and second toggles within the toggle block 196. When the first and second toggles are asserted, an RCV_DONE? signal is received by the hardware controller 200. The hardware controller 200 sequentially activates the tri-state buffers 204 to deliver the data from the first and second timers 194, 198 to the bus 206 and over a serial communication line via the UART 208 to the processing unit 20.

After the timeout counter reaches a defined time interval, the hardware controller 200 provides another DRV-XMIT signal. The defined time interval is equal to the period which the position signals 66 are transmitted from the implement 210. This time interval allows the hardware controller 200 to provide DRV-XMIT signals with the same frequency that the position signals 66 are transmitted. Further, the DRV-XMIT signals are provided at approximately the same time the position signals 66 are transmitted. As a result, the reference signal 64 serves to synchronize the DRV-XMIT signals with the transmission of position signals 66. The reference signal 64 can be transmitted with a frequency which is sufficient to prevent drift in the synchronization between the transmission of the position signals and the DRV-XMIT signals.

In each of Figures 8A-8C, the hardware unit 14 includes control switches 182. Signals from the control switches 182 and the position signal receiver 60 are received by the hardware controller 200. Suitable control switches 182 include, but are not limited to

toggle switches and contact switches. Each hardware unit 14 also includes indicators 184 which can be activated by the hardware controller 200 or the processing unit. The indicators can be used to indicate to the user various conditions of the system. Suitable indicators include, but are not limited to, an LED, an LCD display, an LED display, a speaker for providing audible messages, a beeper and a buzzer.

In operation, the control switches 182 can be activated by the user. Based on the particular control switch 182 which is activated, the hardware controller 200 can perform a particular function itself or can load a second control signal onto the bus 206. The processing unit 20 can include logic for identifying the second control signal and carrying out a function in response to the particular control signal. Examples of functions which can be carried out by the hardware unit 14 or the processing unit are described above.

The hardware controller 200 can include logic for identifying various signals encoded into the position signals or encoded into the reference signals. For instance, the hardware controller 200 can include logic which identifies a power signal, an identity signal and/or a pressure signal encoded into position signals 66 or reference signals. In response to identifying at least one of these signals, the hardware controller 200 can load a second power, identity and/or pressure signal onto the bus 206. The second power, identity and pressure signals can be the same or different than the power, identity and pressure signals which were originally received. The hardware controller 200 can also activate an indicator 184 in response to identifying one of these signals. For instance, the indicator can be an LED and the hardware controller 200 can light the LED in response to identifying a power signal. As discussed above, the hardware controller 200 can include logic for identifying the implement 210 based on the response of the implement 210 to an inquiry signal. When the implement 210 has been identified, an identity signal can be loaded onto the bus 206. The processing unit 20 is in communication with the bus 206 and can include logic for identifying and responding to at least one of the signals which have been loaded onto the bus 206. The response of the processing unit 20 to identifying these signals will be discussed in more detail below.

The hardware controller 200 can also include logic for identifying error conditions. Example error conditions include, but are not limited to, a user's hand blocking a portion of the position signal transmitter and a detector 12A, 12B being

moved after the system was calibrated. These error conditions can be identified when one of the detectors 12A, 12B receives a position signal while the other detector does not. The error condition can be identified when an RCV_DONE? signal is not received before the next cycle is begun as indicated by transmission of a position signal. The lack of the RCV_DONE? signal indicates that only one or none of the toggles were asserted before a new cycle was initiated as indicated by transmission of a position signal. When this condition is met for some pre-determined number of cycles, an error condition has occurred. The user can be notified of this indication via an indicator 184. For instance, the indicator can be an LED which flashes when the error condition is identified or a speaker which produces an audible message or an audible beep. Further, the hardware unit 14 can load an error signal onto the bus so it can be received by the processing unit. The processing unit can include logic for identifying the error signal and responding to it. For instance, upon identifying the error signal, the processing unit can cause an error message to appear on the monitor.

The hardware controller 200 illustrated in Figures 8A-8C can include logic for identifying when the implement 210 has been removed from the writing area 38. For instance, when position signals are not received for some pre-determined period of time, the implement can be characterized as being removed. One method for determining that the pre-determined period of time is elapsed is to monitor the number of times that the timeout counter 202 consecutively reaches the timeout limit. When a pre-determined number of timeouts has been achieved, the implement 210 is characterized as being removed from the writing area 38. The number of timeouts that should occur before the implement 210 is characterized as removed from the writing area 38 is preferably 1-20, more preferably 2-10 and most preferably 2-3.

The hardware controller 200 can also include logic for communicating to the processing unit 20 that the implement 210 has been removed from the writing area 38. As illustrated in Figures 8A-8C, signals from the hardware controller 200 can be received by the bus 206. When the hardware controller 200 identifies that the implement 210 has been removed from the writing area 38, the hardware controller 200 can load a stylus removed signal onto the bus 206. The processing unit 20 includes logic for identifying the stylus removed signal and adjusting the monitor image 34 accordingly.

The hardware controller 200 can also be coupled with detector circuits 190, 192 within the first or second detector 12A, 12B. The hardware controller 200 can include logic for identifying a re-calibrate signal provided by the detector electronics. As described above, the re-calibrate signal occurs when the first or second detector 12A, 12B has been removed from the writing surface 28. In response to identifying the re-calibrate signal, the hardware controller 200 can load a second re-calibrate signal onto the bus where it can be accessed by the processing unit. In response, the processing unit can initiate a re-calibration of the system.

The hardware controller 200 can also include logic for encoding inquiry signals into the reference signals 64 transmitted from the reference signal transmitter 62. As described in more detail below, these inquiry signals are identified by the implement 210 which can respond to the inquiry signal. The sequence of inquiry signals and responses can be used to identify the implement 210.

In each of Figures 8A-8C, the hardware controller 200 is coupled with a temperature sensor 212 so as to receive a temperature signal from the temperature sensor 212. There is a known relationship between the speed of sound and temperature. As will be described in detail below, the speed of sound can play a role in calibration of the transcription system and determining the position of the stylus 10. As a result, the hardware controller 200 can produce a second temperature signal which is received by the processing unit 20. The processing unit 20 can process the second temperature signal to determine the speed of sound which can then used in calibration and position calculations. The processing unit 20 can also include logic for monitoring the second temperature signal and periodically recalculating the speed of sound. Alternatively, the hardware controller 200 can include logic for processing the temperature signal to determine the speed of sound. The hardware controller 200 can then produce a speed of sound signal which is received by the processing unit 20. The processing unit 20 can then process the speed of sound signal to determine the speed of sound for use in calculations. The hardware controller can also include logic for periodically monitoring the temperature sensor 212 and updating the speed of sound signal.

Although the temperature sensor 212 is illustrated as being located within the hardware unit 14, the temperature sensor is preferably located where it can be positioned

close to the writing surface 28 during operation of the transcription system. Proximity to the writing surface 28 provides information regarding the temperature at the writing surface 28 where changes in the temperature are most likely to influence the transcription system. Suitable locations for the temperature sensor 212 include, but are not limited to, a first detector 12A, second detector 12B, or coupling member 74. The temperature sensor 212 can also be included in an independent module which can be coupled to the writing surface 28. Further, the temperature sensor 212 can be coupled directly to the processing unit 20. As a result, the processing unit 20 can receive and process the temperature signal directly. Additionally, the transcription system can include a plurality of temperature sensors 212 in different locations to maximize the accuracy of temperature determinations or to identify the existence of temperature gradients. Suitable temperature sensors 212 include, but are not limited to, thermocouples and thermistors.

The hardware units 14 illustrated in Figures 8A-8C can include an internal power source such as a battery or can include a cable to an external power source such as a wall socket or the processing unit 20. The hardware units 14 can also include a power switch, such as a toggle switch, for turning the hardware unit 14 on and/or off. One of the indicators 184 can indicate whether the hardware unit 14 is on or off. For instance, the indicator 184 can be an LED which is lit when the hardware unit 14 is switched in. Further, the hardware unit 14 can include a power level sensor for detecting a level of power available to the hardware unit 14. When the available power level falls below a particular threshold level, this can be indicated to the user by an indicator 184. For instance, the indicator 184 can be an LED which is lit when the power level falls below the threshold or an LED used to indicate whether the hardware unit 14 is on or off can flash when the power level falls below a particular threshold.

The block diagrams illustrated in Figure 8A-8C can be readily adapted for use with other transcription system embodiments, such as the transcription system embodiments illustrated in Figures 2B-2D. For example, in order to adapt the block diagrams for use with the transcription system illustrated in Figure 2B, the reference signal transmitter 62 and the reference signal receiver 56 can be replaced with a wire for carrying the reference signal 64.

In Figures 8A-8C, the first and second detector circuits 190, 192 are illustrated as being positioned in the first and second detectors 12A, 12B. It is noted, however, that the first and second detector circuits 190, 192 may also be included in the hardware unit 14. Further, the reference signal transmitter 62 is illustrated as being positioned in the second detector 12B in Figures 8A and 6B. However, the reference signal transmitter 62 can also be positioned in other locations within the system including the hardware unit 14. Further, although the hardware unit is illustrated as a housing containing electronics, the hardware unit can refer to a collection of electronics which perform the functions discussed as being performed within the hardware unit. As a result, the hardware unit is conceivably distributed among several locations.

The block diagrams illustrated in Figures 8A-8C can be adapted for use with other systems. For instance, the block diagram illustrated in Figure 8A can be adapted for use with the system illustrated in Figure 3B by including a reference signal receiver 56 within the first detector 12A and replacing the position signal receiver 60 in the first detector 12A with a position signals transceiver 70. The first detector 12A can then be designed so the position signal transceiver 70 responds to receiving a reference signal 64 during calibration of the system by transmitting a position signal 66.

An example of a trigger circuit 188 that may be included in the implement electronics 104 is illustrated in Figure 9. The trigger circuit 188 triggers the position signal transmitter 58 to transmit a position signal 66 in response to a reference signal receiver 56 receiving a reference signal 64. The circuit can be included in the stylus 10 or in the eraser 16. The trigger circuit 188 includes a transistor 214, a first node 220, a second node 222 and a transformer 224. An n-channel MOSFET transistor is shown with a self-contained zener diode, but other suitable devices might also be used. A power source 226 is coupled with the first node 220. Suitable power sources 226 include, but are not limited to, a battery such as a 5 V battery. Suitable position signal transmitters include, but are not limited to, an ultrasound transducer.

The first node 220 is also coupled with the transformer. A suitable transformer transforms the 5 V signal to a 570 V peak-to-peak signal. The transformer 224 is coupled with the source of the transistor 214. The drain of the transistor is coupled with the ground. The transformer 224 is coupled with the ultrasound transducer 58. A

resistor 216 is coupled in parallel between the transformer to assist in damping electrical ringing. When the potential at the second node 222 exceeds a threshold potential, current flows from the power source 226, through the transformer 224 and the transistor 214, to the ground. The voltage output from the transformer 224 drives the ultrasound transducer 58. As a result of this configuration, the ultrasound position signal 66 is triggered by the IR reference signal 64.

As shown above, the second node 222 is coupled with the base of the transistor 214. The second node 222 can also be coupled with additional electronics within the implement electronics 104 and/or a reference signal detector via an amplifier (not shown). The second node 222 can also be coupled with the hardware unit 14 via an electrical wire 68 as illustrated in Figure 2B. When the second node 222 is coupled with the hardware unit 14, the ultrasound position signal 66 is triggered by a reference signal 64 received via the electrical wire 68. Similarly, when the second node 222 is coupled with a reference signal receiver, the ultrasound position signal 66 is triggered by a reference signal 64 received at the reference signal receiver.

Figure 10 illustrates a detector circuit which may be used as the first and/or second detector circuit illustrated in Figures 8A-8C. The detector circuit is typically included in the detector electronics 130 but may be positioned in another location within the system. The detector circuit includes an amplifier 230, a low pass filter 232, rectifier 234 and a comparator 236. In operation, the signal received at the position signal receiver 60 is amplified and then filtered. The filtered signal is then rectified. The rectified signal is provided to the comparator which provides a signal when the signal from the rectifier rises above some threshold value. The signal from the comparator indicates that a position signal 66 has been received at the position signal receiver 60.

In the circuit illustrated in Figure 10, the presence of the rectifier 234 improves the quality of the monitor image 34. One source of error in creation of the monitor image 34 results when the leading edge of the position signal 66 does not exceed the comparator's 236 threshold value but a subsequent part of the same signal does exceed the threshold value. This error results in the stylus 10 appearing further from first and second detectors 12A, 12B than the true location of the stylus 10. Rectifying the signal increases the opportunity for the comparator's threshold value to be exceeded and the

position signal 66 detected. The earlier a position signal 66 is detected, the less severe the error described above. As a result, the rectifier 234 serves to reduce the error resulting from missed position signals 66.

Converting Time of Flight Signals to a Recorded Image:

Figures 11A-11B illustrate how the time of flight measurements may be translated into an image on a monitor image area 36. The first and second detectors 12A, 12B are displaced by a distance, L. The writing area 38 has a width dimension, W, a height dimension, H and a diagonal direction, D. Similarly, the monitor image area 36, has a width dimension, w and a height dimension h. Each of these dimensions are illustrated in Figure 11A. The L, H and W dimensions can be known values or can be determined during calibration of the system. Once, the H and W dimensions are determined, the monitor image area 36 is created on the monitor 22. The monitor image area 36 is created with a h:w ratio which matches the ratio of H:W. As a result, the actual h and w values can vary. After the monitor image area 36 is created, the size and dimensions of the monitor image area 36 can be adjusted by the user using traditional techniques for manipulating windows. For instance, a mouse can be used to click and drag an edge or corner of the monitor image area 36. Further, the size of the monitor image 34 relative to the monitor image area 36 can be magnified and reduced by the user with traditional techniques for magnifying and reducing images on a monitor. An example of a typical techniques for user magnification and reduction of images and image areas is used in drawing programs such as VISIO, etc.. Scroll bars can be included on the monitor image area 36 to scroll to portions of the monitor image 34 which are not currently displayed on the monitor. It is conceivable that the user may write outside the writing area 38. When a user writes outside the writing area, the processing unit can include logic for expanding the size of the monitor image area 36 to accommodate positions outside the writing area 38.

As illustrated in Figure 11B, a Cartesian coordinate system can be transposed on the writing area 38. The coordinate system is transposed on the writing area 38 so the corners of the writing area 38 is positioned at (0, 0), (0, H), (W, 0) and (W, H). The

position of the stylus 10 relative to the corners of the writing area 38, (x, y), can be determined using Equation 1 and Equation 2.

$$x=\frac{L^2-r^2+l^2}{2L} \qquad \text{Equation 1}$$

$$y=(l^2-x^2)^{1/2} \qquad \text{Equation 2}$$

As illustrated in Figure 11B, the variable l represents the distance between the stylus 10 and the first detector 12A. The variable r represents the distance between the stylus 10 and the second detector 12B. The variables r and l can be calculated from Equation 3 and Equation 4.

$$l=Ct_1 \qquad \text{Equation 3}$$

$$r=Ct_2 \qquad \text{Equation 4}$$

The variable t_1 is the time of flight of the position signal 66 between the stylus 10 and the first detector 12A and t_2 is the time of flight of the position signal 66 between the stylus 10 and the second detector 12B. C is the speed of sound. As described above, C can be a function of temperature. As described above, the transcription system can include a temperature sensor 212 and logic for determining the speed of sound from temperature measurements. As a result, when the transcription system includes a temperature sensor 212, the determined speed of sound is used in these calculations. When the transcription system does not include a temperature sensor 212, the speed of sound at standard conditions can be used.

$$y=\frac{L^2+l^2-r^2}{2L} \qquad \text{Equation 5}$$

$$x=(r^2-y^2)^{1/2} \qquad \text{Equation 6}$$

Figure 11C illustrates the first and second detectors 12A, 12B positioned along a side of the writing area 38. The Cartesian coordinate system transposed on the writing area 38 illustrated in Figure 11B is transposed on the writing area 38 illustrated in Figure 11C. Although the coordinate system is the same, the changed position of the first and second detectors 12A, 12B relative to writing area 38 requires a different set of equations to determine the stylus position, (x, y). The stylus position, (x, y), can be determined using Equation 5 and Equation 6.

As illustrated in Figures 11B and 11C, a Cartesian coordinate system is also transposed on the monitor image area 36. The corners of the monitor image area 36 are defined as (0, 0), (0, H), (W, 0) and (W, H) so they are correlated to the position of the writing area corners 38. As a result, the stylus position, (x, y), on the writing area 38 translates to a position on the monitor image area 36.

Creation of the monitor image 34 is illustrated in Figure 11D. The stylus position, (x, y) is periodically sampled as the stylus is moved along the writing area 38. For instance, during the stroke illustrated in Figure 11C, the stylus position during each sample is expressed as a set of Cartesian coordinates, (x_n, y_n). The sampled positions are then translated to positions on the monitor image area 36. The image forms when line segments are drawn between consecutively sampled positions which have been translated to the monitor. The resolution of the monitor image 34 can be increased by increasing the frequency that the stylus position, (x, y), is sampled. Further, the resolution of the monitor image 34 can also be smoothed with position filtering logic as will be discussed below.

Data Structures:

Figure 12 provides a block diagram of an embodiment of the system. The processing unit 20 illustrated includes a processor 238 in communication with a memory 240 including a volatile memory 242 and a storage unit 244. Suitable processing units 20 include, but are not limited to, IBM and Macintosh personal computers and central servers. The processor 238 is also in communication with the hardware unit 14 via an input/output unit 246 and a serial channel 248. Suitable processors 238 include, but are not limited to, microprocessors and CPUs. The storage unit can include logic and various data structures. The volatile memory 242 is utilized during execution of the logic included in the storage unit 244.

Figure 13 illustrates a data structure for an image data structure which can be stored in the memory 240. The image data structure includes a column of x fields 250 correlated with y fields 252. As described above, the position of the stylus 10 relative to the detectors is periodically sampled as the stylus 10 is moved along the writing area 38. The Cartesian coordinates for the sampled positions are stored in the image data structure. The x coordinate for each sampled position is stored in an x field and the y coordinate for the position is stored in the corresponding y field.

The monitor image 34 is created by forming lines between sequential positions in the image data structure to form a stroke. Certain rows can include break entries which indicate that the stylus 10 was removed from the writing surface 28. These entries are created when an activation or deactivation signal 66 has been received as discussed above. When such an entry exists, lines, splines and the like may be drawn between the series of positions following the entry but not between positions on opposite sides of the entries. As a result, a second stroke is created which is independent of the first stroke.

Figure 14 illustrates an implement characteristic data structure 254 which can be stored in the memory 240. The implement characteristic data structure 254 includes a column of implement identifier fields 256 correlated with implement fields 258, first implement characteristic fields 260 and second implement characteristic fields 262. The implement identifier field 256 lists an identifier which can be unique to each type of implement which can be used on the writing area 38. For instance, each type of stylus 10 and each type of eraser 16 can be identified by a unique number. Each implement field

258 lists whether the implement is an eraser 16, a stylus 10 or other implement which can be used on the writing area 38. The first implement characteristic field 260 and the second implement characteristic field 262 list characteristics of the implement identified in the corresponding implement field 258. For instance, when the identified implement is a stylus 10, the first implement characteristic field 260 can list information indicating the color or thickness of the stroke left by the stylus 10. The implement characteristic data structure 254 can optionally include additional implement characteristic fields which can list additional implement characteristics.

The implement characteristic data structure 254 is used to identify the implement being used on the writing area 38. As a result, when the eraser 16 is being used on the writing area 38, the monitor image 34 is erased. Further when the stylus 10 is being used on the writing area 38, the characteristics correlated with the identified stylus 10 can be used to create each stroke on the monitor image 34. For instance, when a blue stylus 10 is used to write on the writing area 38, the strokes which appears on the monitor image 34 can be created with a blue color. As a result, the characteristics of the monitor image 34 can be reflected in the written image 44.

It is noted that the system can be adjusted such that when strokes of different colors cross over each other, the system may either display one stroke on top of the other stroke, or illustrate the overlapping portion of the strokes as a mixture of the different colors. For example, when a blue stroke is written over a yellow stroke, the system may either record the overlapping portion as being the first stroke (yellow), the last stroke (blue), or a combination of the two strokes (green). By providing a mixture of the different colored strokes, the actual appearance of the image formed by the different strokes can be better simulated.

Figure 15A illustrates an control section relative to template data structure which can be stored in the memory 240. The control section relative to template data structure includes a function field 264 and a plurality of coordinate fields 266-280. The plurality of coordinate fields include an x' upper left corner field 266, a y' upper left corner field 268, an x' upper right corner field 270, a y' upper right corner field 272, an x' lower left corner field 274, a y' lower left corner field 276, an x' lower right corner field 278 and a y' lower right corner field 280. The x' upper left corner field 266 and the y' upper left

corner field 268 lists the coordinates of the upper left corner of a particular control section 32 on the template 18. Similarly, the remaining coordinate fields 270-280 list the coordinates for other corner of the particular control section 32. The coordinates are listed relative to the template 18. For instance, an imaginary or real coordinate system can be transposed on the template 18 with the origin of the coordinate system located at one calibration mark 40 and an axis of the coordinate system extending through another calibration mark 40. The coordinates listed in fields 266-280 are measured on the transposed coordinate system. As a result, the listed coordinates indicate the spatial relationship of each control section 32 relative to the calibration marks 40.

Each set of coordinate fields 266-280 is correlated with a function field 264 which lists a function performed by the hardware unit 14 or the processing unit 20 when the stylus 10 is positioned within the control section 32 defined by the coordinate fields 266-280. For instance, when the stylus is positioned within an control section 32 with coordinates corresponding to the function field 264 labeled "print", the hardware unit 14 or the processing unit 20 will cause the monitor image 34 to be printed. Similarly, when the stylus is positioned within an control section 32 with coordinates corresponding to the function field 264 labeled "2", the hardware unit 14 or the processing unit 20 will cause the number 2 to be displayed in the display 48 of the calculator image 46.

Figure 15B illustrates an control section relative to detectors data structure which can be stored in the memory 240. The control section relative to detectors data structure includes function fields 264 similar to the function fields listed in the control section relative to template data structure. The control section relative to detectors data structure also includes a plurality of coordinate fields 282-296. The plurality of coordinate fields 282-296 include an x upper left corner field 282, a y upper left corner field 284, an x upper right corner field 286, a y upper right corner field 288, an x lower left corner field 290, a y lower left corner field 292, an x lower right corner field 294 and a y lower right corner field 296. The x upper left corner field 282 and the y upper left corner field 284 respectively list the x and y coordinates of the upper left corner of a particular control section 32 on the template 18. Similarly, the remaining fields 286-296 list the coordinates for other corners of the control section 32. The coordinates are listed relative to the detectors 12A, 12B. Specifically, the coordinates listed in fields 282-296 are

measured on a coordinate system such as the coordinate systems illustrated in Figure 11B and/or Figure 11C. As a result, the listed coordinates indicate the spatial relationship of each control section 32 relative to the detectors 12A, 12B.

The data structures illustrated in Figures 15A and 15B presume control sections 32 which are rectangular in shape, however, it is contemplated that control sections 32 with alternative shapes are also suitable for use with the template 18. For instance, the control sections 32 can be circular, triangular, elliptical, etc.. A single template 18 can include control sections 32 with a single control section 32 geometries or with different geometries. When the template 18 includes circular control sections 32, the data structures illustrated in Figure 15A and 15B can include fields which contain information defining the position of the center of the circles and fields which contain information defining the diameter of the circles. Similarly, when the template 18 includes triangular control sections 32, the data structures illustrated in Figure 15A and 15B can include fields which contain information defining the positions of each of the three corners of the triangles.

Process Flows:

The transcription system can optionally include calibration logic, stylus identification logic, image creation logic and overlay calibration logic. The transcription system can also optionally include handwriting recognition logic for converting the monitor image 34 directly into ASCII text or converted directly into presentation software such as Microsoft Power Point. Any of the logic discussed above or below can be included on a computer readable medium which can be loaded onto the processing unit 20 or the hardware controller 200 The logic may also be stored remotely and loaded onto a local processor unit or the hard ware unit by electronic transmission over a public network, such as the INTERNET. Suitable computer readable media include, but are not limited to, computer disks, floppy disks, compact disks, tapes such as magnetic tapes, personal digital assistants, hand held computers. Similarly, the logic can be remotely stored and accessed via a network or modem.

The calibration logic guides the user in calibrating the system and can determine variables required for operation of a particular embodiment of the transcription system.

For instance, the calibration logic can include logic for determining a displacement between detectors, a displacement between calibration marks and the detectors, a displacement between a template and the detectors, and a displacement between a control section and the detectors, and the writing area dimensions. As will be described in more detail below, the logic required can vary between different embodiments of the transcription system.

The calibration logic may be accessed when the user installs the transcription system on a new writing surface. The calibration logic can also be accessed at the command of the user when the user feels the system may have become uncalibrated. The re-calibrate command can be given by activating a particular control switch 182, by positioning the stylus within the perimeter of a particular control on the template, section or by using a user interface to provide particular input to the processing unit or hardware unit. Further, the calibration logic can be broken up into smaller bits of logic which can be accessed independently as will be described below.

An example of calibration logic process flow is illustrated in Figure 16A. Portions of the calibration logic which pertain to logic for determining the detector displacement, the control section positions and the writing area dimensions are labeled as such in the brackets along the left edge of Figure 16A. The process flow of Figure 16A is suitable for use with the systems illustrated in Figures 2A-2D which can require use of the template 18 during the determination of the displacement between the detectors. Because the template is used during the determination of the displacement between the detectors 12A, 12B and during determination of the control section positions, there can be some overlap in the logic used to determine the control section positions and in the logic used to determine the detector displacement. This overlap is illustrated by labeled brackets which vertically overlap in Figure 16A.

The logic for determining the writing area dimensions can be independent from the logic for determining detector displacement and control section position as illustrated by the brackets in Figure 16A. As a result, it is conceivable that different portions of the calibration logic can be accessed independently, i.e. at different times during operation of the transcription system. For instance, the user can determine control section positions several times but determine the writing area dimensions once but As a result, the user

can move the template 18 to a new position on a writing surface and then determine the new control section positions without having to re-determine the dimensions of the writing area.

In Figure 16A, control is passed from the start block 298 to process block 300. At process block 300 the user is directed to touch the stylus 10 to the calibration mark 40 in the upper left corner of the template 18. The direction takes the form of creating a template image 42 on the monitor 22 and showing a stylus 10 contacting the upper left corner of the template 18 as discussed with respect to Figure 1C. Control is then passed to process block 302 where the time for the position signal 66 to pass from the stylus 10 to the first detector 12A and the second detector 12B, t_1 and t_2, is accessed from the bus 206. Control is then passed to process block 304 where r and l are calculated via Equation 3 and Equation 4. The calculated r and l are stored as r_1 and l_1. Control is then passed to process block 306 where the user is directed to touch the stylus 10 to the calibration mark 40 in the upper right corner of the template 18. Control is then passed to process block 308 where the time for the position signal 66 to pass from the stylus 10 to the first detector 12A and the second detector 12B, t_1 and t_2, is accessed from the bus 206. Control is then passed to process block 310 where r and l are calculated via Equation 3 and Equation 4. The calculated r and l are then stored as r_2 and l_2.

$$L = \frac{((l_2^2 - l_1^2) - (r_2^2 - r_1^2))}{2W_T} \qquad \text{Equation 7}$$

$$H = y_1 + C \qquad \text{Equation 8}$$

Control is passed from process block 310 to process block 312 where the displacement between the detectors, L, is determined by using the stored r_1, l_1, r_2, and l_2 in Equation 7, where w_T is a known constant equal to the width between the calibration marks 40 on the template 18. The calculated L is then stored.

Control is passed from process block 312 to process block 314 where the coordinates of the control sections 32 on the template 18 is determined relative to the detectors 12A, 12B. L, r_1, l_1, r_2 and l_2 are used in Equation 1 and Equation 2 to determine

and store the coordinates of the calibration marks 40 relative to detectors 12A, 12B. As discussed above, the control section relative to template data structure lists the coordinates of the control sections 32 relative to the calibration marks 40 on the template 18. Using traditional principles of geometry, these coordinates can be used in combination with the determined positions of the calibration marks 40 relative to the detectors, to determine the coordinates for the control sections 32 relative to the detectors 12A, 12B. The determined coordinates for the control sections are entered into the appropriate fields of the control section relative to detectors data structure.

Control is passed form process block 314 to process block 316 where the user is prompted to position the stylus within a particular one of the control sections 32. The prompt can take the form of the prompts discussed above with respect to process blocks 300 and 306. Control is then passed to decision block 318 where a determination is made whether the position of the control sections relative to the detectors has been properly calculated. The determination can be made by calculating r and l for when the stylus is positioned within the perimeter of the particular control section at process block 316. The determined r and l are used in Equations 1 and 2 to determine the position of the stylus 10 relative to the detectors. The determined position is checked against the fields of the control section relative to detectors data structure which correspond the particular control section to determine whether the determined position falls within the particular control section. When the determined position does not fall within the perimeter of the particular control section, the determination is negative and control is passes to process block 320. At process block 320 the user is provided with an error message indicating an error during the calibration. For example, the error message can be a readable massage shown on the monitor or an indicator on the hardware unit can be activated to indicate the error condition. Control is returned from process block 320 to process block 300.

When the determination at decision block 318 is positive, control is passed to process block 322 where the dimensions of the writing area 38, W and H, are determined using one of several techniques. For instance, the user can be presented with a menu of typical writing area dimensions on the monitor 22 and the user can then use a user interface 24 to select the appropriate writing area dimensions from the menu.

Additionally, the user can use a user interface 24 to directly enter the dimensions of the writing area 38 into the processing unit. In another technique where the first and second detectors 12A, 12B define the writing area 38 and the template is positioned along a bottom edge of the writing area as illustrated in Figure 11B, W can be set equal to the stored L. To determine H, the L, r_1 and r_2 determined as described above are used in Equations 1 and 2 to determine y_1 for the upper left calibration mark 40. The determined y_1 is then used in Equation 8 to determine the writing area height, H, where C is a constant equal to about the height of the template 18. Equations 7 and 8 are appropriate for use with the transcription system illustrated in Figure 11B but can be easily adapted to the transcription system of Figure 11C using the principles of triangulation. Once the writing area dimensions are determined by any of the above techniques, W and H are stored along with the calculated L.

Control is passed from process block 322 to process block 324 where the writing

$$D=(H^2+W^2)^{1/2} \qquad \text{Equation 9}$$

area diagonal 38 is determined via Equation 9 and stored. The timeout limit is then determined by dividing the length of the diagonal, D, by the speed of sound. The timeout limit can be stored and/or loaded onto the bus 206 where it can be accessed by the hardware controller 200.

Control is passed from process block 324 to process block 326. The ratio of W:H is then calculated and used to define a monitor image area 36 as illustrated in Figure 1D. The monitor image area 36 is the position on the monitor 22 where the monitor image 34 will be formed. The ratio of the length and width of the monitor image area 36, h:w, is equal to the ratio of W:H. Control is then passed to the exit block 328.

As described above, certain embodiments of the transcription system do not require that the timeout limit be calculated such as when the timeout limit is an administratively determined value. As a result, the need to determine the timeout limit as described with respect to process block 324 can be eliminated. Further, if the user does not intend to use the control sections 32 on the template, the need to perform the

functions in process blocks 314-421 can be eliminated. As a result, the logic illustrated in Figure 16A is intended to be illustrative and must be adjusted to accommodate different embodiments of the transcription system.

The calibration logic illustrated in Figure 16A can be easily adapted for use with other transcription systems. For instance, Figure 16B illustrates calibration logic which is similar to the logic illustrated in Figure 16A, however, process block 312 is moved to a position between the start block 298 and the process block 300. Such calibration logic is suitable for use with the systems of Figures 3B-3E.

In the systems of Figure 3B-3E, the determination of the displacement between the detectors 12A, 12B can be independent of the template 18. As a result, the logic for determining the displacement of the detectors, position of the control sections and dimensions of the writing area can be independent of one another as illustrated by the brackets along the left edge of Figure 16B. As a result, in certain embodiments of the transcription system, the user can determine the writing area dimensions and detector displacement once but determine the detector displacement or the control section positions several times. As a result, a user can move the template 18 to a new position on the writing surface and determine the new control section positions without having to re-determine the dimensions of the writing area or re-determine the detector displacement.

The logic used to determine the displacement between the detectors 12A, 12B in the systems of Figures 3B-3E can vary depending on which system is used. To determine the detector displacement with the system of Figure 3C, the user is prompted to position the stylus 10 at the calibration mark 40 on the first detector 12A and the time for the position signal 66 to travel from the first detector 12A to the second detector, t_2, is determined. The displacement between the detectors, L, is then determined by multiplying t_2 by the speed of sound. The dimension L can then stored in the memory and control passed to process block 300 of Figure 16B.

To determine the displacement between the detectors in the system of Figure 3B, the processing unit 20 or hardware unit 14 can cause the reference signal receiver 56 and the position signal transceiver 70 on the first detector 12A to become engaged. The processing unit 20 or hardware unit 14 can also cause a reference signal 64 to be

transmitted from the second detector 12B. The reference signal 64 will be received at the reference signal receiver 56. In response, a position signal 66 is transmitted from the position signal transceiver 70 and the time for the position signal to travel between the first and second detectors, t_2 is determined. The displacement between the detectors, L, is then determined by multiplying t_2 by the speed of sound. The dimension L can then stored in the memory and control passed to process block 300 of Figure 16B.

As described above, certain embodiments of the transcription system do not require that the timeout limit be calculated. As a result, the need to perform the acts described with respect to process block 324 is eliminated. Further, the template is not required for calibration of the transcription systems illustrated in Figures 3B and 3C and can be eliminated from the transcription system. As a result, the need to perform the determine control section position logic can also be eliminated. Consequently, it is conceivable to calibrate the transcription systems illustrated in Figures 3B and 3C by performing only the acts described with respect to process blocks 312, 322, and 326 of Figure 16B.

It is not necessary to determine the displacement between the detectors in the system of Figures 3D and 3E because the coupling member 74 can keep the detectors 12A, 12B at a known displacement. As a result, the determine detector displacement logic can be eliminated from Figure 16B. Additionally, when the timeout limit does not need to be calculated, the need to perform the functions in process blocks 324 is eliminated. Further, the need to perform the determine control section position logic can be eliminated by removing the template 18 from the system. As a result, it the transcription systems of Figures 3D and 3E can be operated by performing only the acts described with respect to process block 322 and 326.

The above calibration logic process flows are intended to be exemplary and are not intended to limit the calibration techniques. For instance, many techniques for determining the writing area dimension as discussed with respect to process block 322 are conceivable but not disclosed. Further, various combinations of the techniques disclosed with respect to process block 322 can also be used to determine the writing area dimensions.

The writing area 38 dimensions calculated during the above calibration logic can be stored in the memory 240 for subsequent uses. As a result, the system does not need to be calibrated each time the system is used. Each time the system is turned on, the user can be asked if the system has been positioned on a new writing surface 28. This inquiry can take the form of a question on the monitor 22. When the user indicates that the system has not been positioned on a new writing surface 28, the processing unit 20 can work from the previously stored writing area 38 dimensions. In other embodiments, the system can depend on the user to calibrate the system when the system is positioned on a new writing surface 28. In these embodiments, the system does not need to inquire whether the system has been positioned on a new writing surface 28. In other embodiments, the bus is monitored for a re-calibrate signal which is placed on the bus by the hardware unit 14 when the first or second detector 12A, 12B has been removed from the writing surface 28. When a re-calibrate signal is identified, the system must be re-calibrated once the system is re-installed on another writing surface 28. As a result, one of the above calibration logic process flows can be accessed when the re-calibrate signal is detected.

A process flow of the image creation logic is illustrated in Figure 17. Control is passed from the start block 330 to decision block 334 where a determination is made whether a stylus 10 or eraser 16 is being used in the writing area 38. This determination can be made by monitoring the bus 206 for signals which are a result of output from a stylus 10 or an eraser 16. When the determination is negative, control is returned to decision block 334. When the determination is positive, control is passed to process block 336 where the implement is identified by monitoring the bus 206 for an identity signal. Control is then passed to decision block 338 where a determination is made whether the implement is an eraser 16. This determination is made by accessing the implement characteristic data structure 254. The implement identity signal is compared with the implement identifier fields 256 until a match is found. The corresponding implement field 258 is accessed to identify whether the implement is a stylus 10 or an eraser 16. When the determination is positive, control is passed to subroutine 340 where the portion of the written image 44 which is erased is also erased from the monitor image 34. Control is then returned to decision block 334.

When the determination at decision block 338 is negative, control is passed to decision block 342 where the first implement characteristic field 260 and the second implement characteristic field 262 corresponding to the identified stylus 10 are accessed. The first and second characteristics of the stylus 10 stored in the memory 240. Control is then passed to process block 344 where t_1 and t_2 are received. Control is then passed to process block 346 where t_1 and t_2 are used in Equations 1 and 2 or 5 and 6, depending on the system being used, to determine the stylus position, (x, y).

Control is passed from process block 346 to decision block 348. At decision block 348, a determination is made whether the stylus position, (x, y), is within any of the control sections 32 of the template 18. The determination can be made by comparing the (x, y) with the coordinates sets listed in the control section relative to detectors data structure. When the determination is negative, control is passed from decision block 348 to process block 350 where the current stylus position, (x, y), is stored in the image data structure.

Control is passed from process block 350 to process block 352 where the image data structure is filtered. For instance, in one filtering technique the position which was most recently stored in the image data structure is compared with a moving average of positions stored before the most recently stored position. If the most recently entered position deviates from the moving average by more than a threshold deviation, the most recently entered position can be rejected by removing it from the image data structure. The number of positions that should be included in the moving average is preferably 2-100, more preferably 2-20 and most preferably 4-10. Another filtering technique includes determining the distance of the most recently entered position from the previously entered position. When the distance is above some threshold displacement, the most recently entered position can be rejected by removing it from the image data structure.

The filtering techniques described above can eliminate two sources of error which can arise during use of the system. One source of error derives from reflections of positions signals 66. During a position detection cycle, a position signal 66 can be reflected off an object such as the user and then interfere with the next detection cycle. Another source of error can result from sudden variations in the system. For instance, the

stylus 10 can suddenly be held at a different angle to the writing surface 28. These sources of error can be eliminated by using either of the filtering techniques disclosed above alone or in combination.

After filtering at process block 352, control is passed to process block 354 where the image data structure is compressed. A single line can be represented as only two positions. As a result, redundant positions along a line can be eliminated to reduce the number of positions necessary to create the monitor image 34. The compression can take the form of fitting the series of positions to a more compact form such as a spline.

Control is passed from process block 354 to process block 356 where the monitor image 34 is updated by plotting the most recent entry in the image data structure on the monitor image 34 and creating a line between the most recent entry in the image data structure and the previous entry in the image data structure. The line is created using the first and second implement characteristic of the stylus 10 which were determined at decision block 342.

When the determination at decision block 348 is positive, control is passed to process block 358. At process block 358, the function listed in the function field correlated with the control section 32 where the stylus 10 is positioned is performed. For instance, a new monitor image area 36 may be created on the monitor 22 so a new monitor image 34 can be created or the previous monitor image 34 may be saved.

Control is passed from process block 356 and process block 358 to decision block 360. At decision block 360, a determination is made whether the stylus 10 is still on the writing area 38. This determination can be made by monitoring the bus 206 for signals which are a result of output from a stylus 10. When a pre-determined period of time passes without detecting such a signal, the determination is negative, however, when such signals are received within the pre-determined period of time, the determination is positive. In another embodiment the determination can be made by monitoring the bus 206 for a stylus removed signal loaded onto the bus 206 by the hardware controller 200. When a stylus removed signal is detected, the determination is negative and when a stylus removed signal is not detected, the determination is positive. In other embodiments, the determination can be made using a combination of these two techniques. When the determination is positive, control is returned to process block 344.

When the determination is negative, control is passed to process block 362 where a break entry is placed in the image data structure. Control is then returned to decision block 334.

The pressure placed on the stylus 10 can also be taken into account during the above process flow. As described above, the hardware controller 200 can load onto the bus 206 a pressure signal which indicates the pressure being placed on the stylus 10 by the user. The processing unit 20 can receive the pressure signal and can include logic for adjusting the width of strokes on the monitor 22 in response to the amount of pressure being placed on the stylus 10. For instance, when a line width is listed in a first or second implement characteristic field 260, 262, the listed line width can be increased or decreased in proportion to the pressure being placed on the stylus 10. When line widths are not listed in the first or second implement characteristic fields 260, 262, a standard line width can be used for each stylus 10. The standard line width can be adjusted according to the amount of pressure being placed on the stylus 10.

Figure 18 illustrates a process flow for an image erasing subroutine. Control is passed from the start block 366 to process block 368 where the time for the position signal 66 to pass from the stylus 10 to the first detector 12A and the second detector 12B, t_1 and t_2, is received. Control is then passed to process block 370 where t_1 and t_2 are used in Equations 1 and 2 or 5 and 6, depending on the system being used, to determine the position of the eraser 16 (x, y). Control is then passed to process block 372 where positions listed on the image data structure which fall within the approximate eraser area 124 are identified. The identification can be made by using a relationship between the approximate eraser area 124 and the position of the eraser 16. For instance, when the eraser 16 has a round shape, the approximate eraser area 124 can be defined to cover all points within two inches of the eraser 16 position. All the positions listed in the image data structure which are within two inches of the eraser 16 position are then identified.

Control is passed from process block 372 to process block 374 where the identified positions are removed from the image data structure. Control is then passed to process block 376 where the monitor image 34 is updated. The image update can take the form of removing from the monitor image 34 the positions which are removed from the image data structure or re-creating the monitor image 34. Control is then passed to

decision block 378 where a determination is made whether the eraser 16 is still positioned on the writing area 38. This determination can be made by monitoring the bus 206 for signals which are a result of output from the eraser 16. When a pre-determined period of time passes without detecting such a signal, the determination is negative, however, when such signals are received within the pre-determined period of time, the determination is positive. In another embodiment the determination can be made by monitoring the bus 206 for an stylus removed signal loaded onto the bus 206 by the hardware controller 200. When an stylus removed signal is detected, the determination is negative and when an eraser removed signal is not detected, the determination is positive. In other embodiments, the determination can be made using a combination of these two techniques. When the determination is positive, control is returned to process block 368. When the determination is negative, control is passed to the return block 379 which returns control to the image creation logic.

The processing unit 20 can also include logic which allows the creation of the monitor image 34 to be played back to the user. This is possible when the monitor image 34 is stored in an image data base as opposed to being stored as a bitmap. During the playback, the monitor image 34 is created by sequentially plotting and connecting the positions listed in the image data structure on the monitor image area 36. The process of plotting and connecting positions is performed at a rate which allows the user to observe the image creation. The playback of the monitor image 34 allows the user to re-capture information which has been erased or can extract information from the actual creation of the monitor image 34. Further, the user can stop the playback at a particular point and edit the image at the point where it was stopped.

As discussed above, several different embodiments of the system can identify the type of implement being used upon the writing area 38. For instance, whether the implement is an eraser 16 or a stylus 10 can be identified as well as the type of the eraser 16 or stylus 10. Different types of styluses 10 can write with different colors or line widths. Different types of erasers 16 can be erasers 16 have a footprint with a different size or shape. Different types of implements are generally listed in the implement characteristic data structure 254 with different implement identifiers.

Figures 19A-19B illustrate one embodiment of implement identification logic. The implement identification logic operates via a series of inquiries and responses between the implement and the hardware controller 200 or the processing unit 20. The implement responds to the inquiries by responding or not responding to the inquiry signals with a position signal 66. The implement identification process flow can be accessed each time the implement produces an activation signal. As a result, the implement is identified each time the implement contacts the writing area 38.

The process flow illustrated in Figure 19A can be included in the hardware controller 200 of the hardware unit 14. The process flow can also be adapted for inclusion in the processing unit 20. Control is passed from the start block 380 to process block 382. At process block 382, an inquiry signal is transmitted to the implement. The inquiry signal can be coded into a reference signal 64. The implement electronics 104 includes logic which receives the reference signal 64 and recognizes the inquiry signal. The logic interprets the inquiry signal as inquiring whether the implement is the same type of implement which was last used on the writing area 38.

Control is passed from process block 382 to decision block 384 where a determination is made whether the implement is a type which matches the type requested by transmission of the inquiry signal. The determination is based on whether the implement responds to the inquiry signal by transmitting a position signal 66. When the implement responds with a position signal 66, the determination is positive and when the implement does not respond, the determination is negative.

When the determination at decision block 384 is negative, control is passed from decision block 384 to process block 386 where an inquiry signal is transmitted to the implement. The implement includes logic which recognizes the signal as inquiring whether the implement is a particular type of implement. Control is then passed to decision block 388 where a determination is made whether the implement is a type which matches the type requested by transmission of the inquiry signal. The determination is based on whether the implement responds to the inquiry signal by transmitting a position signal 66. When the implement responds with a position signal 66, the determination is negative and when the implement does not respond, the determination is positive. When the determination is positive, control is passed to process block 390 where the t_1 and t_2

values for the transmitted position signal 66 are loaded onto the bus 206. Control is then returned to process block 386.

When the determination at decision block 384 is positive, control is passed to process block 392 where the t_1 and t_2 values for the transmitted position signal 66 are loaded onto the bus 206. Control is passed from process block 392 to process block 394. Similarly, when the determination at decision block 388 is positive control is passed to process block 394. At process block 394, an identity signal is loaded onto the bus 206. The processing unit 20 can use the identity signal to match the implement being used with a implement listed in an implement identifier field 256 of the implement characteristic data structure 254. As a result, the processing unit 20 can identify the implement being used on the writing area 38. Control is passed from process block 394 to exit block 396.

Figure 19B illustrates a process flow which is included in the implement electronics 104 and which is complementary to the process flow illustrated in Figure 19A. Control is passed from start block 398 to process block 400 where an inquiry signal is received. The inquiry signal can be coded in a reference signal 64 from a reference signal transmitter 62. The implement electronics 104 can include logic for identifying the inquiry signal. The logic also interprets the inquiry as an inquiry whether the implement is a particular type of implement. Control is passed from process block 400 to decision block 402 where a determination is made whether the implement is the type of implement inquired about in the inquiry signal. When the determination is negative control is returned to decision block 404.

At decision block 404 a determination is made whether the received inquiry signal is the first inquiry signal the implement has received during the period of time the implement has been continuously in contact with the writing area 38. When the determination is negative, control is passed to process block 406 where the implement transmits a position signal 66. Control is then returned to process block 400. Similarly, when the determination at decision block 404 is positive, control is passed to process block 400.

When the determination at decision block 402 is positive, control is passed to decision block 408. At decision block 408 a determination is made whether the received

inquiry signal is the first inquiry signal the implement has received during the period of time the implement has been continuously in contact with the writing area 38. When the determination is positive, control is passed to process block 410 where the implement transmits a position signal 66. Control is passed from process block 410 to exit block 412. Similarly, when the determination at decision block 408 is negative, control is passed to exit block 412.

The above implement identification logic can include additional logic for prioritizing transmission of the inquiry signals. For instance, the inquiry signals can be transmitted so the inquiries pertaining to the most recently used implement types are transmitted at the beginning of a series of inquiries. Further, inquiry signals relating to the least recently used or unused implement types can be transmitted later in the inquiry sequence. For instance, if a red stylus 10 is used first, an eraser 16 second and a black stylus 10 third, the next series of inquiry signals may inquire whether the stylus 10 is a black stylus 10 first, an eraser 16 second and a red stylus 10 third. Because the most recently used implements are most likely to be used for a new stroke, the prioritization scheme minimizes the number of inquiries which must be made to identify the implement. Other priority logic may also be utilized, e.g., always putting the eraser second after the last pen used.

The above implement identification logic also minimizes the number of position data points which are lost because the implement does not transit a position signal 66. The first time a implement receives an inquiry signal, the implement does not respond with a position signal 66 if the implement does not match the implement sought by the inquiry signal. However, each subsequent time the implement receives an inquiry signal, the implement transmits a position signal 66 when the implement does not match the implement sought by the inquiry but does not transmit a position signal 66 when the implement does match the implement sought by the inquiry signal. As a result, a large number of non-matching inquiry signals can be transmitted and a maximum of only two data points will be lost in the process of identifying the implement.

The transcription system can also include calibration logic for calibrating the position of a background image relative to a writing surface. The background image may be positioned adjacent the writing surface (e.g., positioned on or behind the writing

surface), may form the writing surface, or may be projected onto the writing surface. Figure 20 illustrates an example process flow for background image calibration logic. The start block 414 is accessed when the processing unit 20 or the hardware unit 14 is notified that a background image 50 will be used with the transcription system. The user can notify the system that a background image 50 is being used by positioning the stylus tip in a particular one of the control sections 32 on the template 18 or by entering information to the processing unit 20 via the user interface 24. Alternatively, the hardware unit 14 can include a control switch 182 which can be activated to indicate that a background image 50 is being used.

Control is passed from start block 414 to process block 416 where the user identifies the background image 50 which will be used in combination with the writing surface 28. As described above, the composite images 52 can be created internally or externally and then stored in the processing unit 20 as an Image file. Upon saving composite images 52 as Image files, the user can provide each Image file with different identifying characteristics such as different names and/or different locations (i.e. different directories) within the processing unit 20. The different identifying characteristics can be created using traditional file management programs such as WINDOWS 95, PC DOCS and IMANAGE. At process block 416, the user can be presented with a menu listing each of the composite images 52 which has been stored as an Image file or listing each of the Image files in the current directory. The user can scroll through the list to identify the Image file of interest. Once the proper Image file has been identified, the user can select the proper Image file. One suitable method for selecting the proper Image file is using a user interface 24 which controls a cursor, such as a mouse, and double clicking on the identified Image file. Alternatively, the user can select the identified Image file by highlighting the identified Image file and then clicking on a box which may include a word such as "OK".

Control is passed from process block 416 to process block 418 where the user is directed to position the background image 50 upon the writing surface 28. The method for directing the user can be similar to the methods of directing the user to position the stylus in contact with the calibration marks 40. Once the background image 50 is positioned relative to the writing surface 28, the user can notify the processing unit 20

using techniques which are similar to the techniques used to notify the processing unit 20 that an background image 50 will be used. Control is passed from process block 418 to process block 420 where the user is prompted to contact the stylus tip with a calibration mark 40 present on the background image 50. Prompting the user to contact the stylus with the calibration marks 40 on the background image 50 can be similar to the prompts discussed with respect to Figure 1B. For instance, the monitor image 34 can include an image of the stylus contacting the calibration point on the composite image 52. Control is passed to process block 422 where t_1 and t_2 are determined and used in Equations 1-4 to determine the position of the first calibration mark relative to the detectors, (x_1, y_1). Control is passed to process block 424 where the user is directed to contact the stylus tip with a second calibration mark 40 present on the background image 50. Control is passed to process block 426 where t_1 and t_2 are determined and used in Equations 1-4 to determine the position of the second calibration mark 40 relative to the detectors, (x_2, y_2).

Control is passed from process block 426 to process block 428 where the composite image 52 is created upon the monitor 22. The composite image 52 is scaled so the first calibration mark 40 on the composite image 52 is positioned on the monitor image at (x_1, y_1) and the second calibration mark 40 on the composite image 52 is positioned on the monitor image 34 at (x_2, y_2). Control is passed from process block 428 to exit block 430 which can be a return to the start block of the image creation logic.

The logic illustrated in Figure 20 is intended to be illustrative and not intended to be limiting. For instance, as discussed above, the background image 50 can include more than two calibration marks 40 to increase the quality of correlation between the position of the background image 50 on the writing surface 28 and the position of the background image 50 on the image area 36. Increasing the number of calibration marks 40 can increase the number of acts required to perform out the background image calibration.

Additional permutations of the background image calibration logic are also contemplated. For instance, the select background image act illustrated in process block 416 can be replaced with a select background image sequence act. As discussed above a background image sequence can be a sequence of composite images 52 which are established by the user. The user can then advance through the background image sequence to the desired composite image 52. Suitable means for advancing through the

overlay image sequence include, but are not limited to, positioning the stylus tip in a particular one of the control sections 32 on the template 18, entering information via a user interface 24 or activating a control switch 182 on the hardware unit 14. Similar mechanisms can be used to reverse through the background image sequence. Further, when a background image is projected onto the writing surface 28, the projector can be coupled with the processing unit 20 and the background images can be advanced or reversed with the composite images 52.

The transcription system disclosed above is described with a hardware unit 14 which is independent of the processing unit 20. It is noted, however, that the hardware unit 14 and the processing unit 20 can be integrated in a single unit. For instance, the hardware controller 200, the processor 238, the volatile memory 242 and the storage unit 244 can be contained in a single hardware unit 14. The hardware controller 200 and the processor can be integrated into a single processing element. Further, the storage unit 244 and/or the volatile memory can be incorporated into a single memory device. Integrating the hardware unit 14 and the processing unit 20 permits the functions which are characterized above as performed by the processing unit 20 to performed by the hardware unit 14. For instance, the image data structure can be created and stored within the hardware unit 14 as the written image 34 is created. As a result, the monitor image 34 can be stored without using a processing unit 20 and without being displayed on a monitor 22. After the image data structure has been stored in the hardware unit 14, the hardware unit 14 can be coupled with a monitor 22, a printer, a network and/or a processing unit 20. These connections respectively allow the image stored in the hardware unit 14 to be displayed, printed, forwarded to another location or downloaded to another storage medium.

Additionally, while the hardware unit 14 is illustrated above as a housing for a plurality of electronics, it is noted that the hardware unit 14 can refer to any collection of electronics which perform the function(s) of the electronics within the illustrated hardware unit. As a result, the hardware unit can actually be distributed among different locations throughout a transcription system. Further, the hardware unit can be included in several different housings and/or several different types of housings.

Further, the first and second detectors 12A, 12B are disclosed as being removable from a writing surface 28. However, the first and second detectors 12A, 12B can also be integrated with the writing surface 28. In embodiments where the first and second detector 12A, 12B are integrated with the writing surface 28, the calibration acts described above can be eliminated since the writing area 38 dimensions will be constants which can be administratively entered into the system before the system is sold to the end consumer. Additionally, although the system is disclosed with first and second detectors 12A, 12B, additional detectors may be added to the system to facilitate the calibration process, to provide additional resolution to the monitor image 34 or the further refine the monitor image 34.

EXAMPLE

The following is an example of a transcription system according to the present invention, its contents and operation. Figure 21 illustrates a transcription system kit. As illustrated, the kit includes a detector assembly 512, a set of styli 514, a set of whiteboard markers 516, an eraser 518, and a template 520.

Figure 22 illustrates a stylus 514 which has been taken apart so that a marker 516 can be placed within the stylus 514. As illustrated, the stylus 514 includes a stylus body 522 which houses a AAA battery 524 and an ultrasound transmitter 526 adjacent a writing end 528 of the stylus. The stylus 514 also includes a side cover 530 which is sufficiently clear or translucent such that one can see the marker 516 through the side cover 530. The stylus 514 also includes a cap 532 which is sufficiently clear or translucent such that one can see a writing tip of the marker 516 through the cap 532.

Figures 23A and 23B illustrate a stylus 514 containing a marker 516. Figure 23A illustrates a side view of the stylus 514 where the stylus cover 530 is in full view. As illustrated, the writing tip 538 of the marker is uncapped and the cap 532 is attached to an end 536 of the stylus 514 opposite the writing end 528. As can be seen in Figure 23A, the marker 516 is in full view within the stylus 514 through the stylus cover 530.

Figure 23B illustrates a side view of the stylus 514 where the stylus cover 530 is on top and the stylus body 522 is below. As illustrated, the writing tip 538 of the marker 516 is capped by the cap 532. The cap 532 preferably seals the writing tip to prevent the

marker 516 from drying out. As can be seen, the cap 532 is sufficiently clear or translucent such that one can see the writing tip 538 of the marker through the cap 532. This allows the user to rapidly identify the color of the marker.

Figure 24A illustrates the detector assembly 512 unfolded (folded in Figure 21). The detector assembly includes two signal receivers 534A, 534B, two suction cup assemblies with attachment levers 536A, 536B and a series of user inputs 538A-E.

Figure 24B illustrates the detector assembly 512 attached to a whiteboard surface via the suction cup assemblies.

Figure 24C illustrates the user inputs 538A-E on the detector assembly 512. The new board input causes the transcription system software to save what has been inputted on the whiteboard and to open a new blank file for capturing transcription information. The bookmark board input causes the transcription system software to save what has been inputted on the whiteboard while retaining the currently displayed information. The print board input causes what is currently being electronically displayed by the transcription system to be printed. The maximize board input causes the transcription system application window to be maximized and make the transcription system application the active window. The locate template input causes the transcription system software to activate the run a protocol to determine the position of the template on the whiteboard.

Figure 25 illustrates how the detector assembly 512 can be attached to a processor via a connection cable 540, in this instance a processor of a personal computer. As illustrated, the detector assembly 512 includes a data port 542 to which a detector assembly connector 544 on the connection cable 540 can be attached. The connection cable 540 also includes a serial connector 546 for connecting the connection cable 540 to one of the serial ports 549 of the personal computer. As illustrated, the connection cable 540 includes a keyboard passthrough 547. As a result, it is possible to connect the keyboard passthrough 547 to the keyboard port 548 of the personal computer and connect the keyboard 551 to the keyboard passthrough 547. When the detector assembly 512 is connected to the personal computer, a light 553 on the detector assembly 512 goes on.

Figure 26A illustrates a user interface 550 for the transcription system. As illustrated, the user interface 550 illustrates putting the detector assembly 512 in the

upper left hand corner of the writing surface. Figure 26B illustrates a whiteboard 552 with a detector assembly 512 attached and a smiley face 554 written using a transcription system stylus. Figure 26B also illustrates the user interface 550 which shows an electronically transcribed image 556 of the smiley face 554.

Figure 27A illustrates the user interface 550 in greater detail and some of the functions which the user interface 550 performs. For example, the user interface 550 includes a board display area 558 where captured data is displayed. The user interface 550 also includes various toolbars. Three of the most common toolbars are illustrated: The main toolbar 560 includes various common Windows functions including open, delete, save and print. The display toolbar 562 allows the user to change the way the data is being viewed (zoom, multiple board view, etc.). The pen toolbar 564 allows the user to alter the user to input or edit data with virtual pens and erasers. As with most Windows applications, the menu bar 566 allows the user to access program features. Most of the functionality provided through the menu bar can be more readily accessed through the toolbars. The navigation toolbar 570 allows the user to alter various configuration options including board size and pen color. The playback toolbar 571 allows the user to take a recorded transcription session and to playback the transcription session. As illustrated, user can go to the beginning, move back, play, stop, move forward, or go to the end. The playback toolbar 571 also includes a sliding lever 573 which allows the user to move to any portion of the recorded transcription session by moving the sliding lever 573.

Figure 27B illustrates the display toolbar 562 and its operation. As illustrated, the display toolbar 562 includes a button for a multiple board view, a single board view, and a full screen view. Also illustrated is a single board and multiple board display. The display toolbar 562 also includes a button for notes. Pressing the notes button brings up a notes window which may contain additional information about the image being displayed.

Figure 27C illustrates the navigation toolbar 570 and its operation. As illustrated, the navigation toolbar 570 includes buttons for next board, previous board, zoom full, zoom in, and zoom out. Figure 27C also illustrates a screen 572 where a box 574 has

been drawn around a portion 576 of an image 578 and a screen 580 where the portion 576 of the image 578 has been enlarged to fit the screen 576.

Figure 27D illustrates the template 520 in greater detail. As illustrated, the template includes a series of user inputs, many of which also appear on the detector assembly 512. The new board input causes the transcription system software to save what has been inputted on the whiteboard and to open a new blank file for capturing transcription information. The bookmark board input causes the transcription system software to save what has been inputted on the whiteboard while retaining the currently displayed information. The print board input causes the transcription system software to print what is currently being electronically displayed by the transcription system. The maximize board input causes the transcription system software to maximize the transcription system application and make the transcription system application the active window.

The template 520 also includes first and second calibration marks 584, 586 which the transcription system uses to determine the position of the template 520 relative to the detector assembly 512 a writing surface, as discussed in Figures 27E(1)-27E(4).

The template 520 also includes a calculator which allows the user to operate the transcription system and perform calculations at the writing surface using a stylus.

The template 520 also includes a mouse region 592 which serves as a virtual touch pad for the user. The user can move a stylus within the mouse region 592 and cause a cursor associated with the system to move. Thus, by moving the stylus within the mouse region 592, the stylus can serve as a mouse for the system.

The template 520 also includes a graffiti region 594 which can recognize handwritten signals, such as handwriting graffiti used with the PALM PILOT. The system includes logic for utilizing the movement of the stylus within the graffiti region 594 and translating that movement into handwritten signals.

Figures 27E(1)-27E(4) illustrate the template 520 and the detector assembly 512 on a writing surface 582 [Figure 27E(1)] and a sequence of images [Figures 27E(2-4)] displayed on a user interface to allow the transcription to determine the position of the template 520 relative to the detector assembly 512 on the writing surface 582. In order to

initiate this sequence, the user may press the locate template input on the detector assembly 512 [Figure 54C].

As illustrated in Figure 27E(2), the user is directed to contact a first calibration mark 584 on the template 520 with the stylus. Once the user contacts the first calibration mark 584 with the stylus, the user interface changes [Figure 27E(3)] and directs the user to contact a second calibration mark 586 on the template 520. Once the user contacts the second calibration mark 586 with the stylus, the user interface changes [Figure 27E(4)] and directs the user to contact the checkmark box 588 on the template 520. After performing this sequence, the transcription system knows the position of the template 520 relative to the detector assembly 512 and the user can employ the template 520.

Figures 28A and 28B illustrate two windows which may be accessed by the navigation toolbar 570. Figure 28A illustrates a window which allows the user to configure the writing surface. Figure 28B illustrates a window which allows the user to configure the stylus.

Once data has been introduced into the transcription system, the data can be exchanged with various application in many different ways. For example, a Windows clipboard can be used to export images from the transcription system into other applications. Alternatively, images can be identified, dragged and dropped into other applications. Alternatively, transcription system files can be saved in a variety of different formats and then opened by other applications.

The transcription system can be used locally or networked with other computers which include the transcription system operating system. For example, the transcription system operating system can support network conferencing through Microsoft's NETMEETING™ software.

While the present invention is disclosed by reference to the preferred embodiments and examples detailed above, it is to be understood that these examples are intended in an illustrative rather than limiting sense, as it is contemplated that modifications and combinations will readily occur to those skilled in the art, which modifications and combinations will be within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A detector for use in a transcription system comprising:

a signal receiver for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receiver producing a timing signal in response to receiving the position signal; and

a signal focussing element having a reflecting surface which is shaped and oriented relative to the signal receiver to reflect the position signal transmitted from the stylus onto the signal receiver.

2. The detector according to claim 1, wherein at least a portion of the reflecting surface has a curved shape.

3. The detector according to claim 1, wherein at least a portion of the reflecting surface has a parabolic shape.

4. The detector according to claim 3, wherein the signal receiver is positioned adjacent a focus of the parabolic shaped portion of the reflecting surface.

5. The detector according to claim 1, wherein the detector further comprises a mechanism for removably attaching the detector to the writing surface.

6. A detector for use in a transcription system comprising:

a signal receiver for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receiver producing a timing signal in response to receiving the position signal;

a signal focussing element having a reflecting surface which is oriented relative to the signal receiver to reflect the position signal transmitted from the stylus onto the signal receiver; and

a signal shielding element shaped and oriented relative to the signal receiver to reflect position signals transmitted by the stylus away from the signal receiver when the stylus is positioned outside a predetermined region of the writing surface.

7. The detector according to claim 6, wherein at least a portion of the reflecting surface has a curved shape.

8. The detector according to claim 6, wherein at least a portion of the reflecting surface has a parabolic shape.

9. The detector according to claim 8, wherein the signal receiver is positioned adjacent a focus of the parabolic shaped portion of the reflecting surface.

10. The detector according to claim 6, wherein the detector further comprises a mechanism for removably attaching the detector to the writing surface.

11. The detector according to claim 6, wherein the signal shielding element is shaped and oriented relative to the signal receiver to reflect position signals transmitted by the stylus away from the signal receiver when the stylus is positioned adjacent the writing surface outside of an angular range of about 70 to 110 degrees extending outward from the detector parallel to the writing surface.

12. The detector according to claim 11, wherein the angular range is about 90 degrees.

13. The detector according to claim 6, wherein the signal shielding element is shaped and oriented relative to the signal receiver to reflect position signals transmitted by the stylus away from the signal receiver when the stylus is positioned adjacent the writing surface outside of an angular range of about 160 to 200 degrees extending outward from the detector parallel to the writing surface.

14. The detector according to claim 13, wherein the angular range is about 180 degrees.

15. A detector for use in a transcription system comprising:

a signal receiver for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receiver producing a timing signal in response to receiving the position signal; and

a signal shielding element shaped and oriented relative to the signal receiver to reflect position signals transmitted by the stylus away from the signal receiver when the stylus is positioned outside a predetermined region of the writing surface.

16. A detector assembly for use in a transcription system comprising:

first and second signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the first and signal receivers each producing timing signals in response to receiving the position signal; and

first and second signal focussing elements, each focusing element having a reflecting surface which is shaped and oriented relative to one of the signal receivers to reflect the position signal transmitted from the stylus onto the signal receiver.

17. The detector assembly according to claim 16, wherein at least a portion of the reflecting surface of one or more of the focussing elements has a curved shape.

18. The detector assembly according to claim 16, wherein at least a portion of the reflecting surface of one or more of the focussing elements has a parabolic shape.

19. The detector assembly according to claim 18, wherein the signal receivers are positioned adjacent foci of the parabolic shaped portions of the reflecting surfaces.

20. The detector assembly according to claim 16, wherein the detector assembly further comprises a mechanism for removably attaching the detector assembly to the writing surface.

21. The detector assembly according to claim 16, wherein the detector assembly further comprises a member coupling the first and second signal receivers, the coupling member being capable of adopting two or more configurations where a distance between the first and second signal receivers changes in at least two of the configurations.

22. The detector assembly according to claim 21, wherein the coupling member is capable of telescopic expansion and contraction.

23. The detector assembly according to claim 21, wherein the coupling member includes a hinge by which the signal receivers can be angularly moved relative to each other.

24. The detector assembly according to claim 21, wherein the coupling member includes at least two hinges.

25. The detector assembly according to claim 21, wherein the coupling member includes an attachment mechanism for removably attaching the detector assembly to a writing surface.

26. The detector assembly according to claim 21, wherein the coupling member holds the first and second signal receivers a predetermined distance apart from each other when the detector assembly adopts at least one of the configurations.

27. The detector assembly according to claim 21, wherein the coupling member includes a locking mechanism for releasably locking the detector assembly in at least one of the configurations.

28. The detector assembly according to claim 27, wherein the locking assembly holds the first and second signal receivers a predetermined distance apart from each other.

29. The detector assembly according to claim 21, wherein a hardware unit which receives signals from the first and second signal receivers is removably coupleable to the detector assembly.

30. The detector assembly according to claim 21, wherein the first and second signal receivers are removably attachable to the coupling member.

31. The detector assembly according to claim 21, wherein the detector assembly is capable of adopting a first configuration where the first and second signal receivers are separated from each other and a configuration where the first and second signal receivers are positioned adjacent each other.

32. The detector assembly according to claim 21, wherein the detector assembly is capable of adopting a first configuration where the first and second signal receivers are a first distance apart and a second configuration where the first and second signal receivers are a second distance apart that is less than 75% of the first distance.

33. The detector assembly according to claim 21, wherein the detector assembly is capable of adopting a first configuration where the first and second signal receivers are a first distance apart and a second configuration where the first and second signal receivers are a second distance apart that is less than about 50% of the first distance.

34. The detector assembly according to claim 21, wherein the detector assembly is capable of adopting a first configuration having a first lateral footprint and second configuration having a second lateral footprint that is less than 75% of the first lateral footprint.

35. The detector assembly according to claim 21, wherein the detector assembly is capable of adopting a first configuration having a first lateral footprint and second configuration having a second lateral footprint that is about 50% of the first lateral footprint.

36. The detector assembly according to claim 21, wherein the detector assembly is capable of adopting a first configuration having a first lateral footprint and second configuration having a second lateral footprint that is between about 25% and 70% of the first lateral footprint.

37. The detector assembly according to claim 21, wherein the detector assembly further comprises a hardware unit which receives timing signals produced by the signal receivers, the hardware unit including logic for processing the timing signals to determine a time of flight of the position signal from the stylus to the detectors.

38. The detector assembly according to claim 37, wherein the assembly further comprises a rectifier connected in series between the signal receivers and the hardware unit such that the hardware unit receives the timing signal from the signal receivers via the rectifier.

39. The detector assembly according to claim 38, wherein the assembly further comprises a comparator connected in series between the rectifier and the hardware unit such that the hardware unit receives the timing signal from the rectifier via the comparator.

40. A detector assembly comprising:

a first signal receiver for receiving position signals transmitted from a stylus of a transcription system;

a second signal receiver for receiving the position signals transmitted from the stylus; and

a member coupling the first and second signal receivers, the coupling member being capable of adopting two or more configurations where a distance between the first and second signal receivers changes in at least two of the configurations.

41. The detector assembly according to claim 40, wherein the coupling member is capable of telescopic expansion and contraction.

42. The detector assembly according to claim 40, wherein the coupling member includes a hinge by which the signal receivers can be angularly moved relative to each other.

43. The detector assembly according to claim 40, wherein the coupling member includes at least two hinges.

44. The detector assembly according to claim 40, wherein the coupling member include first and second sub-members which may be detached from each other.

45. The detector assembly according to claim 40, wherein the coupling member includes an attachment mechanism for removably attaching the detector assembly to a writing surface.

46. The detector assembly according to claim 45, wherein the mechanism for removably attaching the detector assembly to a writing surface is a suction cup.

47. The detector assembly according to claim 40, wherein the coupling member holds the first and second signal receivers a predetermined distance apart from each other when the detector assembly adopts at least one of the configurations.

48. The detector assembly according to claim 40, wherein the coupling member includes a locking mechanism for releasably locking the detector assembly in at least one of the configurations.

49. The detector assembly according to claim 48, wherein the locking assembly holds the first and second signal receivers a predetermined distance apart from each other.

50. The detector assembly according to claim 40, wherein a hardware unit which receives signals from the first and second signal receivers is removably coupleable to the detector assembly.

51. The detector assembly according to claim 40, wherein the first and second signal receivers are removably attachable to the coupling member.

52. The detector assembly according to claim 40, wherein the detector assembly further includes at least one signal focussing element having a reflecting surface which is positioned and oriented relative to at least one of the signal receivers to reflect the position signals transmitted from the stylus onto the signal receiver.

53. The detector assembly according to claim 40, wherein detector assembly further includes a signal shielding element positioned and oriented relative to at least one of the signal receivers to reflect position signals transmitted by the stylus away from the signal receiver when the stylus is positioned outside a predetermined region.

54. The detector assembly according to claim 40, wherein the detector assembly is capable of adopting a first configuration where the first and second signal receivers are separated from each other and a configuration where the first and second signal receivers are positioned adjacent each other.

55. The detector assembly according to claim 40, wherein the detector assembly is capable of adopting a first configuration where the first and second signal receivers are a first distance apart and a second configuration where the first and second signal receivers are a second distance apart that is less than 75% of the first distance.

56. The detector assembly according to claim 40, wherein the detector assembly is capable of adopting a first configuration where the first and second signal receivers are a first distance apart and a second configuration where the first and second signal receivers are a second distance apart that is less than about 50% of the first distance.

57. The detector assembly according to claim 40, wherein the detector assembly is capable of adopting a first configuration having a first lateral footprint and second configuration having a second lateral footprint that is less than 75% of the first lateral footprint.

58. The detector assembly according to claim 40, wherein the detector assembly is capable of adopting a first configuration having a first lateral footprint and second configuration having a second lateral footprint that is less than about 50% of the first lateral footprint.

59. The detector assembly according to claim 40, wherein the detector assembly is capable of adopting a first configuration having a first lateral footprint and second configuration having a second lateral footprint that is between about 5% and 75% of the first lateral footprint.

60. The detector assembly according to claim 40, wherein the detector assembly is capable of being operated under battery power.

61. The detector assembly according to claim 40, wherein the detector assembly is capable of being operated under battery power from a laptop computer.

62. The detector assembly according to claim 40, wherein the detector assembly is capable of being operated under battery power having a voltage between 1.5 and 24 volts.

63. The detector assembly according to claim 40, wherein the detector assembly is capable of being operated under battery power having a voltage between 1.5 and 12 volts.

64. A detector assembly comprising:

a first signal receiver for receiving position signals transmitted from a stylus of a transcription system;

a second signal receiver for receiving the position signals transmitted from the stylus;

a hardware unit which receives signals from the first and second signal receivers in response to the first and second signal receivers receiving a position signal from the stylus and produces signals encoding the times of flight of the position signals from the stylus to the signal receivers; and

a member coupling the first and second signal receivers, the coupling member being capable of adopting two or more configurations where a distance between the first and second signal receivers changes in at least two of the configurations.

65. The detector assembly according to claim 64, wherein the coupling member is capable of telescopic expansion and contraction.

66. The detector assembly according to claim 64, wherein the coupling member includes a hinge by which the signal receivers can be angularly moved relative to each other.

67. The detector assembly according to claim 64, wherein the coupling member includes an attachment mechanism for removably attaching the detector assembly to a writing surface.

68. The detector assembly according to claim 67, wherein the mechanism for removably attaching the detector assembly to a writing surface is a suction cup.

69. The detector assembly according to claim 64, wherein the detector assembly is capable of being operated under battery power.

70. The detector assembly according to claim 64, wherein the detector assembly is capable of being operated under battery power from a laptop computer.

71. A stylus for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the stylus comprising:

a stylus housing defining a volume for housing a writing element, an opening on a distal end of the stylus housing through which a portion of the writing element extends for writing on a writing surface, and a door on a side of the stylus housing which may be opened or removed and through which a writing element can be introduced into and removed from the stylus housing; and

the position signal transmitter for transmitting the position signal.

72. A stylus according to claim 71 wherein the position signal transmitter transmits an ultrasound signal.

73. A stylus according to claim 71 wherein the position signal transmitter transmits a radar signal.

74. A stylus according to claim 71 wherein the position signal transmitter transmits a micro-impulse radar signal.

75. A stylus according to claim 71 wherein the stylus further includes a reference signal transmitter for transmitting a reference signal when the writing element is sensed by the contact switch to be in contact with the writing surface.

76. A stylus according to claim 75 wherein the reference signal transmitter transmits an infra-red signal.

77. A stylus according to claim 71 wherein the stylus further includes a contact switch for sensing when the writing element is contacted with a writing surface, the position signal transmitter transmitting the position signal when the writing element is sensed by the contact switch to be in contact with the writing surface.

78. A stylus according to claim 77 wherein the stylus further includes a reference signal transmitter which transmits a reference signal when the writing element is sensed by the contact switch to be in contact with the writing surface.

79. A stylus for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the stylus comprising:

a stylus housing defining a volume for housing a writing element and an opening on a distal end of the stylus housing through which a portion of the writing element extends for writing on a writing surface, the stylus housing including a removable adapter for adjusting the volume of the housing to accommodate a particular type of writing element to be positioned within the housing; and

a position signal transmitter for transmitting the position signal.

80. A stylus according to claim 79 wherein the particular type of writing element is selected from the group consisting of whiteboard marker, pen, pencil and chalk.

81. A stylus according to claim 79 wherein the particular type of writing element is a color of writing element.

82. A stylus according to claim 79 wherein the particular type of writing element is a brand of writing element.

83. A stylus according to claim 82 wherein the removable adaptor is color coordinated with a color of the writing element.

84. A stylus for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the stylus comprising:

a stylus housing defining a volume for housing a writing element and an opening on a distal end of the stylus housing through which a portion of the writing element extends for writing on a writing surface, at least a portion of the stylus housing being clear or opaque such that it is possible to see the writing element within the housing; and

a position signal transmitter for transmitting the position signal.

85. A stylus according to claim 84 wherein the clear or opaque portion is sized and positioned to allow a user to determine a color of the writing element through the portion.

86. A stylus according to claim 84 wherein the clear or opaque portion is sized and positioned to allow a user to see an amount of writing media that the writing element contains.

87. A stylus for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal

from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the stylus comprising:

a stylus housing defining a volume for housing a writing element, an opening on a distal end of the stylus housing through which a portion of the writing element extends for writing on a writing surface, and an aperture which allows a user to rotate a writing element about its longitudinal axis housed within the stylus housing without having to disassemble the stylus housing or remove the writing element from the stylus housing; and

a position signal transmitter for transmitting the position signal.

88. A stylus for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the stylus comprising:

a stylus housing defining a volume for housing a writing element and an opening on a distal end of the stylus housing through which a portion of the writing element extends for writing on a writing surface;

a position signal transmitter for transmitting the position signal; and

a cap removably attachable to the stylus housing distal end and sized to cover the portion of the writing element which extends from the stylus housing distal end.

89. A stylus according to claim 88 wherein the cap is clear or opaque.

90. A stylus according to claim 88 wherein the cap is formed of a material which allows a user to observe the color of the writing element without having to remove the cap.

91. A stylus according to claim 88 wherein the position signal transmitter is positioned adjacent the distal end of the stylus housing and the cap is sized to fit over the position signal transmitter.

92. A stylus according to claim 18 wherein the stylus further includes a sensor adjacent the distal end of the stylus housing for detecting a condition of media in the stylus.

93. A stylus for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the stylus comprising:

a position signal transmitter; and

a stylus housing defining a volume for housing a removable writing element which includes a power source for providing operating power to the stylus, a portion of the volume for housing the writing element including a power source contact area for placing the stylus in electrical contact with the writing element power source.

94. A stylus according to claim 93 wherein the stylus housing further includes a writing tip and a conduit for communicating writing media from the writing element to the writing tip.

95. A stylus according to claim 93 wherein at least a portion of the stylus housing is clear or opaque such that it is possible to see the writing element within the housing.

96. A stylus according to claim 95 wherein the clear or opaque portion is sized and positioned to allow a user to determine a color of the writing element through the portion.

97. A stylus according to claim 93 wherein the position signal transmitter transmits an ultrasound signal.

98. A stylus according to claim 93 wherein the position signal transmitter transmits a radar signal.

99. A stylus according to claim 93 wherein the position signal transmitter transmits a micro-impulse radar signal.

100. A stylus according to claim 93 wherein the stylus further includes a cap which is clear or opaque.

101. A stylus according to claim 93 wherein the position signal transmitter is positioned adjacent the distal end of the stylus housing, the stylus further including a cap which is sized to fit over the position signal transmitter.

102. A kit for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the kit comprising:

a stylus including

a position signal transmitter, and

a stylus housing defining a volume for housing a removable writing element which includes a power source for providing operating power to the stylus, a portion of the volume for housing the writing element including a power source contact area for placing the stylus in electrical contact with the writing element power source; and

a removable writing element including

a writing element housing sized to fit within the volume of the stylus housing,

writing media contained within the writing element housing,

a power source for providing operating power to the stylus, and

power source contacts positioned on the writing element housing such that the power source contact area is in electrical contact with the power source contacts when the writing element is positioned within the stylus housing.

103. A kit according to claim 102 wherein the stylus housing further includes a writing tip and a conduit for communicating writing media from the writing element to the writing tip, the writing element further including a port for communicating writing media to the writing tip on the stylus housing.

104. A kit according to claim 102 wherein at least a portion of the stylus housing is clear or opaque such that it is possible to see the writing element within the housing.

105. A kit according to claim 104 wherein the clear or opaque portion is sized and positioned to allow a user to determine a color of the writing element through the portion.

106. A kit according to claim 102 wherein the position signal transmitter transmits an ultrasound signal.

107. A kit according to claim 102 wherein the position signal transmitter transmits a radar signal.

108. A kit according to claim 102 wherein the position signal transmitter transmits a micro-impulse radar signal.

109. A kit according to claim 102 wherein the kit further includes a cap which is clear or opaque.

110. A kit according to claim 102 wherein the position signal transmitter is positioned adjacent the distal end of the stylus housing, the stylus further including a cap which is sized to fit over the position signal transmitter.

111. A writing element for use in a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from the stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, the writing element comprising:

a writing element housing sized to fit within a stylus adapted for use in the transcription system;

writing media contained within the writing element housing;

a power source for providing operating power to the stylus; and

power source contacts positioned on the writing element housing such that the power source contacts are in electrical contact with a power source contact area on the stylus when the writing element is positioned within the stylus.

112. A writing element according to claim 111 wherein the writing element further includes a port for communicating writing media through a conduit in the stylus housing to a writing tip on the stylus housing.

113. A method for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the method including:

positioning a pad adjacent the writing surface, the pad including one or more input sections;

positioning the stylus adjacent a particular input section, the stylus transmitting a position signal in response;

determining that the stylus has been positioned adjacent the particular input section and performing a function associated with the particular input section in response.

114. A method according to claim 113 wherein the input section is a calibration mark, the function performed by the transcription system being calibration of the transcription system by determining a separation between the signal receivers.

115. A method according to claim 113 wherein the function associated with the input section is modifying an image displayed on a monitor operatively connected to the transcription system, the transcription system modifying the image in response to determining that the stylus contacted the save input section.

116. A method according to claim 113 wherein the function associated with the input section is saving an image displayed on a monitor operatively connected to the transcription system, the transcription system saving the image in response to determining that the stylus contacted the save input section.

117. A method according to claim 113 wherein the function associated with the input section is erasing an image displayed on a monitor operatively connected to the transcription system, the transcription system erasing the image in response to determining that the stylus contacted the save input section.

118. A method according to claim 113 wherein the function associated with the input section is changing a color of an image displayed on a monitor operatively connected to the transcription system, the transcription system changing the color of the image in response to determining that the stylus contacted the save input section.

119. A method according to claim 113 wherein the position signal is a sound wave.

120. A method according to claim 113 wherein the position signal is a radar signal.

121. A method according to claim 113 wherein the position signal is a micro impulse radar signal.

122. A method for calibrating a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the method including:

positioning a pad adjacent the writing surface, the pad including a plurality of calibration marks;

positioning the stylus adjacent to each calibration mark, the stylus transmitting a position signal to the signal receivers in response;

determining separations between the signal receivers based on times of flight between the calibration mark and the signal receivers.

123. A method according to claim 122 wherein two calibration marks and two signal receivers are utilized to perform the method.

124. A method according to claim 122 wherein the position signal is selected from the group consisting of a sound wave and a radar signal.

125. A computer program product for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving one or more position signals transmitted from a stylus, the signal receivers producing timing signals in response to receiving the one or more position signals from the stylus, and the computer program product comprising:

a computer usable medium with a computer readable program code embodied therein, and the computer readable program code comprising:

computer readable program code for taking a file encoding positions of one or more input sections on a pad to be positioned adjacent the writing surface and associating with the one or more input sections a function to be performed when the stylus is detected as having been positioned adjacent to one of the input sections;

computer readable program code for determining that the stylus has been positioned adjacent to a particular input section based on times of flight of position signals from the stylus adjacent the particular input section to the plurality of signal receivers; and

computer readable program code for causing the transcription system to perform the function associated with the input section in response to determining that the stylus has been positioned adjacent to the particular input section.

126. The computer readable program code in said computer program product according to claim 125 wherein the input section is a calibration mark and the function performed by the transcription system is calibration of the transcription system by determining a separation between the signal receivers.

127. The computer readable program code in said computer program product according to claim 125 wherein the function associated with the input section is modifying an image displayed on a monitor operatively connected to the transcription system, and the computer usable medium further comprising:

computer readable program code for causing the transcription system to perform a function including causing the transcription system to modify the image in response to determining that the stylus contacted the save input section.

128. The computer readable program code in said computer program product according to claim 125 wherein the function associated with the input section is saving an image displayed on a monitor operatively connected to the transcription system, and the computer useable medium, further comprising:

computer readable program code for causing the transcription system to perform a function including causing the transcription system to save the image in response to determining that the stylus contacted the save input section.

129. The computer readable program code in said computer program product according to claim 125 wherein the function associated with the input section is erasing an image displayed on a monitor operatively connected to the transcription system, and the computer useable medium further comprising:

computer readable program code for causing the transcription system to perform a function including causing the transcription system to erase the image in response to determining that the stylus contacted the save input section.

130. A transcription system comprising:

a stylus which transmits position signals when positioned adjacent a writing surface;

a plurality of signal receivers for positioning adjacent the writing surface which receive the position signals transmitted from the stylus and produce timing signals in response;

a pad for positioning adjacent the writing surface, the pad including one or more input sections; and

a processing unit including logic for taking a file encoding positions of the one or more input sections on the pad and associating with each input section a function to be performed when the stylus is detected as having been positioned adjacent the input section, logic for determining that the stylus has been positioned adjacent an input section based on times of flight of position signals from the stylus adjacent the input section to the plurality of signal receivers, and logic for causing the transcription system to perform the function associated with the input section in response to determining that the stylus has been positioned adjacent to the input section.

131. A transcription system according to claim 130 wherein the function is selected from the group consisting of modifying, saving, and erasing an image displayed on a monitor operatively connected to the transcription system.

132. A transcription system according to claim 130 wherein the input section is a calibration mark and the function performed by the transcription system is calibration of the transcription system by determining a separation between the signal receivers. --.

133. In a transcription system including a plurality of signal receivers positioned adjacent a writing surface, a method for calibrating the transcription system by determining separation distances between the signal receivers comprising:

using times of flight of position signals from at least two calibration marks to the signal receivers to determine separation distances between the at least two calibration marks and the signal receivers; and

using the determined separation distances between the calibration marks and the signal receivers and the known separation distances between the calibration marks to determine separation distances between the signal receivers.

134. A method according to claim 133, wherein the two or more calibration marks are on a template on the writing surface, the method further including determining the position of the template on the writing surface relative to the signal receivers.

135. A method according to claim 134 wherein the template includes one or more control sections at known positions relative to the calibration marks, the method further including determining the position of the one or more control sections relative to the signal receivers.

136. A method according to claim 133 wherein the position signals are sound wave signals.

137. In a transcription system including a plurality of signal receivers positioned adjacent a writing surface, a method for calibrating the transcription system by determining separation distances between the signal receivers comprising:

attaching a template to the writing surface, the template having two or more calibration marks at known separation distances from one another;

transmitting position signals from a stylus at the two or more calibration marks to at the signal receivers;

using times of flight of the position signals from the calibration marks to the signal receivers to determine separation distances between the calibration marks and the signal receivers; and

using the determined separation distances between the calibration marks and the signal receivers and the known separation distances between the calibration marks to determine separation distances between the signal receivers.

138. A method according to claim 137, the method further including determining the position of the template on the writing surface relative to the signal receivers.

139. A method according to claim 137 wherein the template includes one or more control sections at known positions relative to the calibration marks, the method further including determining the position of the one or more control sections relative to the signal receivers.

140. A method according to claim 137 wherein the position signals are sound wave signals.

141. In a transcription system including a plurality of signal receivers for positioning adjacent a writing surface, a method for calibrating the transcription system by determining separation distances between the signal receivers comprising:

attaching the plurality of signal receivers to the writing surface at unknown distances from one another, each signal receiver including a calibration mark at a known position relative to the signal receiver;

transmitting position signals from each calibration mark; and

using times of flight of the position signals to determine separation distances between the plurality of signal receivers.

142. A method according to claim 141 wherein the position signals are transmitted from a stylus by contacting the stylus to the calibration marks.

143. A method according to claim 141 wherein the position signals are sound wave signals.

144. A computer program product comprising:

a computer usable medium having a computer readable program code embodied therein, and the program code comprising:

computer readable program code for taking times of flight of position signals from calibration marks on a template attached to a writing surface to a plurality of signal receivers attached to the writing surface, the calibration marks being at known separation distances from each other, and using the times of flight to determine separation distances between the calibration marks and the signal receivers; and

computer readable program code for using the determined separation distances between the calibration marks and the signal receivers and the known separation distances between the calibration marks to determine separation distances between the signal receivers.

145. The computer readable program code in said computer program product of claim 144, further comprising:

computer readable program code for determining the position of the template on the writing surface relative to the signal receivers.

146. The computer readable program code in said computer program product of claim 144 wherein the template includes one or more control sections at known positions

relative to the calibration marks, and the computer readable program code further comprising:

computer readable program code for determining the position of the one or more control sections relative to the signal receivers.

147. A computer program product for use in a transcription system including a plurality of signal receivers positioned adjacent a writing surface at an unknown separation distance from each other, and the computer program product comprising:

a computer usable medium having a computer readable program code embodied therein, and the program code comprising:

computer readable program code for taking times of flight of position signals from calibration marks to signal receivers and using the times of flight to determine separation distances between the signal receivers.

148. A kit for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving position signals transmitted from a stylus when the stylus is positioned adjacent the writing surface, the transcription system recording writing performed by the stylus on the writing surface, the kit comprising

a background image coupleable to the writing surface; and

a computer readable medium with a computer readable program code embodied therein, and the computer readable program code comprising:

computer readable program code for detecting a position of the background image on the writing surface,

computer readable program code for detecting a position of the stylus relative to the background image on the writing surface,

computer readable program code for recording writing by the stylus relative to the background image, and

computer readable program code for forming a composite image comprising the background image and the writing by the stylus on the background image.

149. The kit of claim 148, wherein the background image comprises a sheet of paper or plastic.

150. The kit of claim 148, wherein the background image is formed of a material which allows the writing by the stylus to be erased.

151. The kit of claim 148, wherein the background image is devoid of electronic circuitry.

152. The kit of claim 148, wherein the background image does not send or receive signals.

153. The kit of claim 148, wherein the background image comprises a blank form of a computer application.

154. The kit of claim 148, wherein the background image comprises a blank form of a spreadsheet.

155. The kit of claim 148, wherein the background image comprises at least two calibration marks and the computer usable medium further comprises:

computer readable program code for determining a position of the background image on a writing surface based on the stylus being positioned adjacent to the background image at the at least two calibration marks.

156. The kit of claim 148, wherein the computer usable medium further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to change when the stylus is placed adjacent to a particular portion of the background image.

157. The kit of claim 148, wherein the computer usable medium further comprises:

computer readable program code for causing the composite image to be saved when the stylus is placed adjacent to a particular portion of the background image.

158. The kit of claim 148, wherein the computer usable medium further comprises:

computer readable program code for causing the composite image to be deleted when the stylus is placed adjacent to a particular portion of the background image.

159. The kit of claim 148, wherein the computer usable medium further comprises:

computer readable program code for causing the composite image to be printed when the stylus is placed adjacent to a particular portion of the background image.

160. The kit of claim 148, wherein the computer usable medium further comprises:

computer readable program code for causing the composite image to be facsimiled when the stylus is placed adjacent to a particular portion of the background image.

161. The kit of claim 148, wherein the computer usable medium further comprises:

computer readable program code for causing the composite image to electronically mailed when the stylus is placed adjacent to a particular portion of the background image.

162. The kit of claim 148, wherein the computer readable medium is selected from the group consisting of: computer disks, floppy disks, compact disks, magnetic tapes, personal digital assistants, hand held computers and hard drives.

163. A computer program product, for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving position signals transmitted from a stylus, the transcription system recording writing performed by the stylus on the writing surface, and the computer program product comprising:

a computer usable medium having a computer readable program code embodied therein, and the program code comprising:

computer readable program code for detecting a position of a background image relative to the writing surface,

computer readable program code for detecting a position of the stylus relative to the background image on the writing surface,

computer readable program code for recording writing by the stylus relative to the background image, and

computer readable program code for forming a composite image comprising the background image and the writing by the stylus on the background image.

164. The computer readable program code in said computer program product of claim 163, further comprising:

computer readable program code for displaying the background image on the writing surface.

165. The computer readable program code in said computer program product of claim 163, wherein the background image includes at least two calibration marks and the computer readable program code further comprising:

computer readable program code for determining a position of the background image relative to the signal receivers based on the stylus being positioned adjacent to the background image at the at least two calibration marks.

166. The computer readable program code in said computer program product of claim 163, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to change when the stylus is positioned adjacent to a particular portion of the background image.

167. The computer readable program code in said computer program product of claim 163, the computer usable medium further comprising:

computer readable program code for causing the composite image to be saved when the stylus is positioned adjacent to a particular portion of the background image.

168. The computer readable program code in said computer program product of claim 163, the computer usable medium further comprising:

computer readable program code for causing the composite image to be deleted when the stylus is positioned adjacent to a particular portion of the background image.

169. The computer readable program code in said computer program product of claim 163, the computer usable medium further comprising:

computer readable program code for the composite image to be printed when the stylus is positioned adjacent to a particular portion of the background image.

170. The computer readable program code in said computer program product of claim 163, the computer usable medium further comprising:

computer readable program code for causing the composite image to be facsimiled when the stylus is positioned adjacent to a particular portion of the background image.

171. The computer readable program code in said computer program product of claim 163, wherein the computer readable medium is selected from the group consisting of computer disks, floppy disks, compact disks, magnetic tapes, personal digital assistants, hand held computers and hard drives.

172. A composite image generation method for a transcription system including detectors and a stylus, the composite image generation method comprising the acts of:

determining a position of a background image adjacent a writing surface relative to detectors positioned adjacent the writing surface;

writing adjacent the background image using the stylus such that a composite image is formed adjacent the writing surface comprising the background image and the writing;

detecting the writing by detecting the position of the stylus relative to the detectors; and

creating an electronic equivalent of the composite image by combining the background image with the writing.

173. A composite image generation method for a transcription system including detectors and a stylus, the composite image generation method comprising the acts of:

positioning a background image relative to the detectors;

determining positions of the stylus relative to the detectors; and

generating a composite image derived from both the background image and the positions of the stylus relative to the detectors.

174. The composite image generation method according to claim 173, further comprising the act of:

displaying the composite image on a monitor coupled to the transcription system.

175. The composite image generation method according to claim 173, wherein the background image is defined on a sheet of material.

176. The composite image generation method according to claim 175, wherein the sheet comprises at least one of a group of materials consisting of: paper and plastic.

177. The composite image generation method according to claim 173, wherein the background image is defined on an erasable sheet of material.

178. The composite image generation method according to claim 173, wherein the background image is defined on a translucent sheet of material.

179. The composite image generation method according to claim 173, wherein the positioning act further comprises the act of:

displaying the background image.

180. The composite image generation method according to claim 173 wherein the positioning act further comprises the act of:

projecting the background image.

181. The composite image generation method according to claim 173 wherein the background image comprises at least one of a group of images consisting of: a screen from a computer application, a website, a spreadsheet, and a grid.

182. The composite image generation method according to claim 173 wherein the background image includes a calibration mark, and

wherein the positioning act further comprises the act of:

determining a position of the background image relative to the detectors by detecting a placement of the stylus adjacent the calibration mark.

183. The composite image generation method according to claim 173 wherein the background image includes a control section, and the composite image generation method further comprising the acts of:

placing the stylus proximate the control section; and

performing a function responsive to the placing act.

184. The composite image generation method according to claim 183 wherein the function performed in said act of performing includes at least one function of a group of functions consisting of: erasing at least a portion of the image, modifying at least a portion of the image, deleting at least a portion of the image, saving at least a portion of the image, and printing at least a portion of the image.

185. A computer program product for use with a transcription system including detectors and a stylus, and the computer program product comprising:

a computer usable medium with a computer readable program code embodied therein, and the computer readable program code comprising:

computer readable program code for positioning a background image relative to the detectors;

computer readable program code for determining positions of the stylus relative to the detectors; and

computer readable program code for generating a composite image derived from both the background image and the positions of the stylus relative to the detectors.

186. The computer readable program code in said computer program product of claim 185, further comprising:

computer readable program code for displaying the composite image on a monitor coupled to the transcription system.

187. The computer readable program code in said computer program product of claim 185, wherein said computer readable program code for positioning a background image further comprises:

computer readable program code for displaying the background image.

188. The computer readable program code in said computer program product of claim 185, wherein said computer readable program code for positioning a background image further comprises:

computer readable program code for projecting the background image.

189. The computer readable program code in said computer program product of claim 185, wherein said computer readable program code for positioning a background image further comprises:

computer readable program code for determining a position of the background image relative to the detectors by detecting a placement of the stylus adjacent a calibration mark defined by the background image.

190. The computer readable program code in said computer program product of claim 185, further comprising:

computer readable program code for detecting a placement of the stylus proximate a control section defined by the background image; and

computer readable program code for performing a function responsive to the detecting act.

191. The computer readable program code in said computer program product of claim 190, wherein the function performed by said computer readable program code includes modifying at least a portion of the image.

192. The computer readable program code in said computer program product of claim 190, wherein the function performed by said computer readable program code includes at least one function of a group of functions consisting of: erasing at least a portion of the image, modifying at least a portion of the image, deleting at least a portion of the image, saving at least a portion of the image, printing at least a portion of the image, and mailing at least a portion of the image.

193. A kit for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving one or more position signals transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving position signals from the stylus, the kit comprising:

a template coupleable to the writing surface, the template including one or more control sections; and

a computer readable medium including:

computer readable program code for detecting when the stylus contacts a particular control section based on receipt by the signal receivers of one or more position signals transmitted from the stylus; and

computer readable program code for causing a function to be performed by the transcription system in response to detecting that the stylus has contacted the particular control section.

194. The kit of claim 193, wherein the template includes a plurality of control sections, and the computer readable medium further comprises:

computer readable program code for causing different functions to be performed depending on which of the plurality of control sections are contacted by the stylus.

195. The kit of claim 193, wherein the template comprises a sheet of paper or plastic.

196. The kit of claim 193, wherein the template is devoid of electronic circuitry.

197. The kit of claim 193, wherein the template does not send or receive signals.

198. The kit of claim 193, wherein the template is adapted to be removably coupleable to a writing surface.

199. The kit of claim 193, wherein the computer readable medium is selected from the group consisting of computer disks, floppy disks, compact disks, magnetic tapes, personal digital assistants, hand held computers and hard drives.

200. The kit of claim 193, wherein the template includes at least two calibration marks and the computer usable medium includes:

computer readable program code for determining a position of the template on the writing surface relative to the signal receivers based on the stylus contacting the template at the at least two calibration marks.

201. The kit of claim 193, wherein the computer usable medium further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to change when the stylus contacts a particular control section.

202. The kit of claim 193, wherein the computer usable medium further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be saved when the stylus contacts a particular control section.

203. The kit of claim 193, wherein the computer usable medium further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be deleted when the stylus contacts a particular control section.

204. The kit of claim 193, wherein the computer readable medium, further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be printed when the stylus contacts a particular control section.

205. The kit of claim 193, wherein the computer usable medium further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be facsimiled when the stylus contacts a particular control section.

206. The kit of claim 193, wherein the computer usable medium further comprises:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to electronically mailed when the stylus contacts a particular control section.

207. The kit of claim 193, wherein the one or more control sections include control sections for performing calculator functions, and the computer usable medium further comprises:

computer readable program code for performing the calculator functions when the stylus contacts particular control sections.

208. The kit of claim 193, wherein the computer useable medium includes a data file identifying the positions of the control sections of the template.

209. The kit of claim 193, wherein the kit includes a plurality of different templates and the computer usable medium further comprising:

at least one data file for the plurality of different templates which identify positions of control sections on each template, and

computer readable program code for allowing a user to select which of the plurality of templates is going to be used.

210. The kit of claim 193, wherein the computer usable medium further comprises:

computer readable program code for allowing a user to specify what function is performed by the transcription system in response to the stylus contacting a particular control section.

211. The kit of claim 193, wherein the template includes at least two calibration marks and the computer readable medium further comprises:

computer readable program code for determining separations between of the signal receivers based on the stylus contacting the template at the at least two calibration marks.

212. A computer program product for use with a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position one or more signals transmitted from a stylus, the signal receivers producing

timing signals in response to receiving the position signal from the stylus, and the computer program product comprising:

a computer usable medium with a computer readable program code embodied therein, and the computer readable program code comprising:

computer readable program code for detecting when the stylus contacts one of a plurality of control sections on a template positioned adjacent the writing surface based on times of flight of position signals transmitted from the stylus to the signal receivers; and

computer readable program code for causing a function to be performed by the transcription system in response to the stylus contacting the control section.

213. The computer program product of claim 212, wherein the template includes a plurality of control sections, and the computer readable program code for causing a function to be performed further comprises:

computer readable program code for causing different functions to be performed depending on which of the plurality of control sections is contacted by the stylus.

214. The computer usable medium of claim 212, wherein the computer readable program code for causing a function to be performed does not utilize signals sent to or received by the template.

215. The computer usable medium of claim 212, wherein the computer readable medium is selected from the group consisting of computer disks, floppy disks, compact disks, magnetic tapes, personal digital assistants, hand held computers and hard drives.

216. The computer usable medium of claim 212, further comprising:

computer readable program code for determining a position of the template on the writing surface relative to the signal receivers based on the stylus contacting at least two calibration marks on the template.

217. The computer usable medium of claim 212, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to change when the stylus contacts a particular control section.

218. The computer usable medium of claim 212, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be saved when the stylus contacts a particular control section.

219. The computer usable medium of claim 212, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be deleted when the stylus contacts a particular control section.

220. The computer usable medium of claim 212, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be printed when the stylus contacts a particular control section.

221. The computer usable medium of claim 212, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to be facsimiled when the stylus contacts a particular control section.

222. The computer usable medium of claim 212, further comprising:

computer readable program code for causing an image displayed on a monitor operatively connected to the transcription system to electronically mailed when the stylus contacts a particular control section.

223. The computer program product of claim 212, wherein the one or more control sections include control sections for performing calculator functions, and the computer useable medium further comprises:

computer readable program code for performing the calculator functions when the stylus contacts particular control sections.

224. The computer usable medium of claim 212, further comprising:

a data file identifying positions of the plurality of control sections on the template.

225. The computer usable medium of claim 212, further comprising:

at least one data file for a plurality of different templates which identify positions of control sections on each template; and

the computer useable medium further comprising:

computer readable program code for allowing a user to select which of the plurality of templates is going to be used.

226. The computer usable medium of claim 212, further comprising:

computer readable program code for allowing a user to specify what function is performed by the transcription system in response to the stylus contacting a particular control section.

227. The computer usable medium of claim 212, further comprising:

computer readable program code for allowing a user to design the template.

228. The computer usable medium of claim 227, further comprising:

computer readable program code for selecting a number of control sections to be included on the template.

229. The computer usable medium of claim 227, further comprising:

computer readable program code for selecting positions of the plurality of control sections on the template.

230. The computer usable medium of claim 227, further comprising:

computer readable program code for associating with each control section a particular function to be performed by the transcription system in response to the stylus contacting the control section.

231. The computer usable medium of claim 212, further comprising:

computer readable program code for determining a position of the first and second signal receivers based on the stylus contacting at least two calibration marks on the template.

232. In a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine a position of the stylus adjacent the writing surface, a detector assembly comprising:

a housing for mounting to the writing surface;

a plurality of signal receivers; and

at least one user activated control switch whose activation by a user when the detector assembly is mounted to the writing surface produces a control signal which causes the transcription system to perform a function in response.

233. A detector assembly according to claim 232 wherein the detector assembly further includes a mechanism for removably mounting the detector assembly to a writing surface.

234. A detector assembly according to claim 234 wherein the mounting mechanism is a suction cup.

235. A detector assembly according to claim 235 wherein the suction cup is cam activated.

236. A detector assembly according to claim 232 wherein activation of one of the control switches causes at least a portion of an image displayed on a monitor operatively connected to the transcription system to be erased.

237. A detector assembly according to claim 232 wherein activation of one of the control switches causes an image displayed on a monitor operatively connected to the transcription system to be saved.

238. A detector assembly according to claim 232 wherein activation of one of the control switches causes an image displayed on a monitor operatively connected to the transcription system to be printed.

239. A detector assembly according to claim 232 wherein activation of one of the control switches causes an image displayed on a monitor operatively connected to the transcription system to be electronically mailed.

240. A detector assembly according to claim 232 wherein activation of one of the control switches causes an image displayed on a monitor operatively connected to the transcription system to be facsimiled.

241. A detector assembly according to claim 232 wherein activation of one of the control switches causes an image displayed on a monitor operatively connected to the transcription system to be modified.

242. A detector assembly according to claim 232 wherein activation of one of the control switches causes a writing property associated with a stylus by the transcription system to be changed.

243. A detector assembly according to claim 232 wherein activation of one of the control switches causes a color associated with a stylus by the transcription system to be changed.

244. A detector assembly according to claim 232, the detector assembly further including a microphone.

245. A detector assembly according to claim 232, the detector assembly further including a power source for operating the detector assembly.

246. A detector assembly according to claim 245, wherein the power source is a battery.

247. A detector assembly according to claim 246, wherein the battery has a voltage of between about 1.5 volts and 24 volts.

248. A detector assembly according to claim 246, wherein the battery has a voltage of between about 1.5 volts and 12 volts.

249. A method for operating a transcription system which includes a plurality of signal receivers for positioning adjacent a writing surface and for receiving a position signal transmitted from a stylus when the stylus is positioned adjacent the writing surface, the signal receivers producing timing signals in response to receiving the position signal from the stylus, the transcription system using the timing signals to determine positions of the stylus adjacent the writing surface and to generate an image therefrom , and the method for operating comprising the acts of:

defining a control section adjacent the writing surface;

positioning the stylus proximate the control section; and

performing a function responsive to the positioning act.

250. A method according to claim 249 wherein the function performed in said act of performing comprises:

erasing at least a portion of the image.

251. A method according to claim 249 wherein the function performed in said act of performing comprises:

saving at least a portion of the image.

252. A method according to claim 249 wherein the function performed in said act of performing comprises:

printing at least a portion of the image.

253. A method according to claim 249 wherein the function performed in said act of performing comprises:

mailing at least a portion of the image.

254. A method according to claim 249 wherein the function performed in said act of performing comprises:

faxing at least a portion of the image.

255. A method according to claim 249 wherein the function performed in said act of performing comprises:

modifying at least a portion of the image.

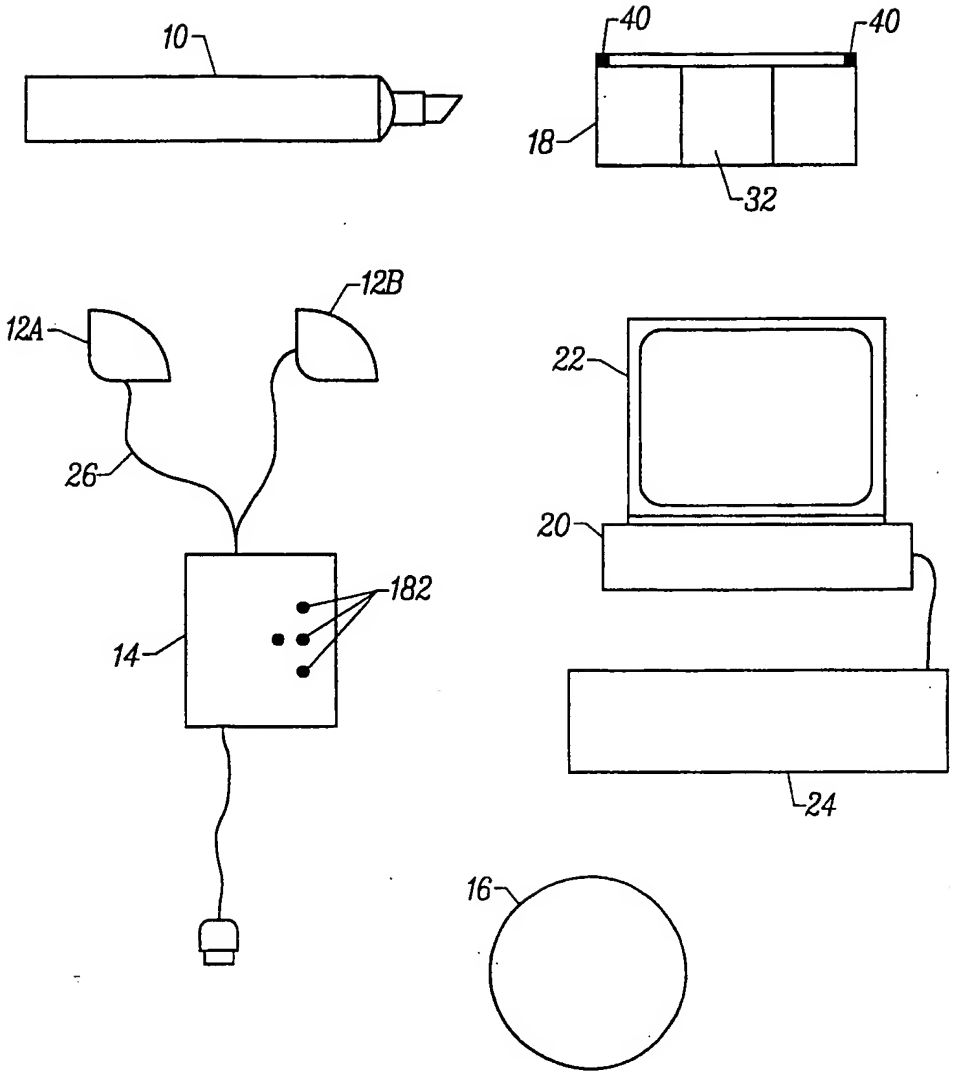

FIG. 1A

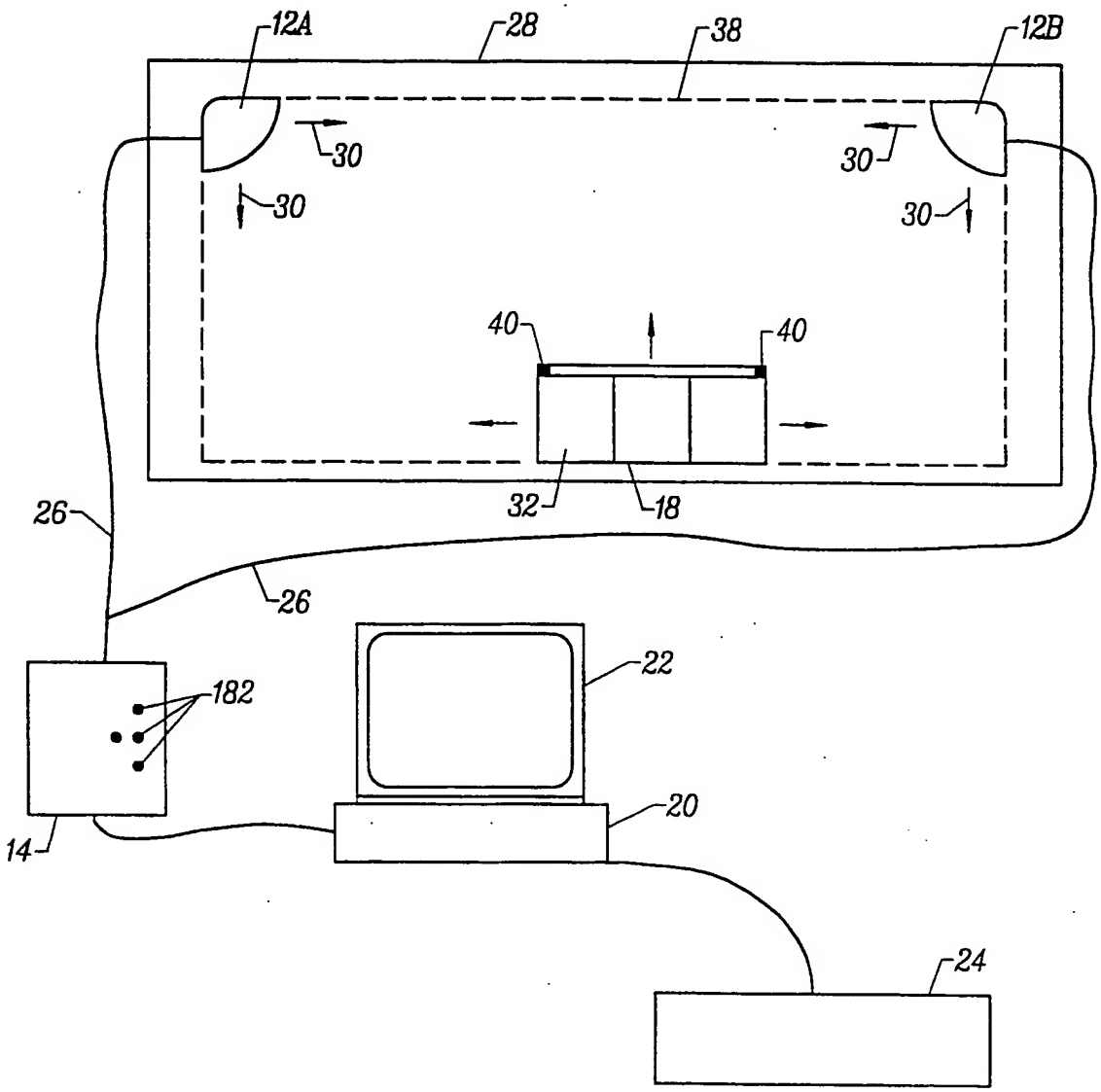

FIG. 1B

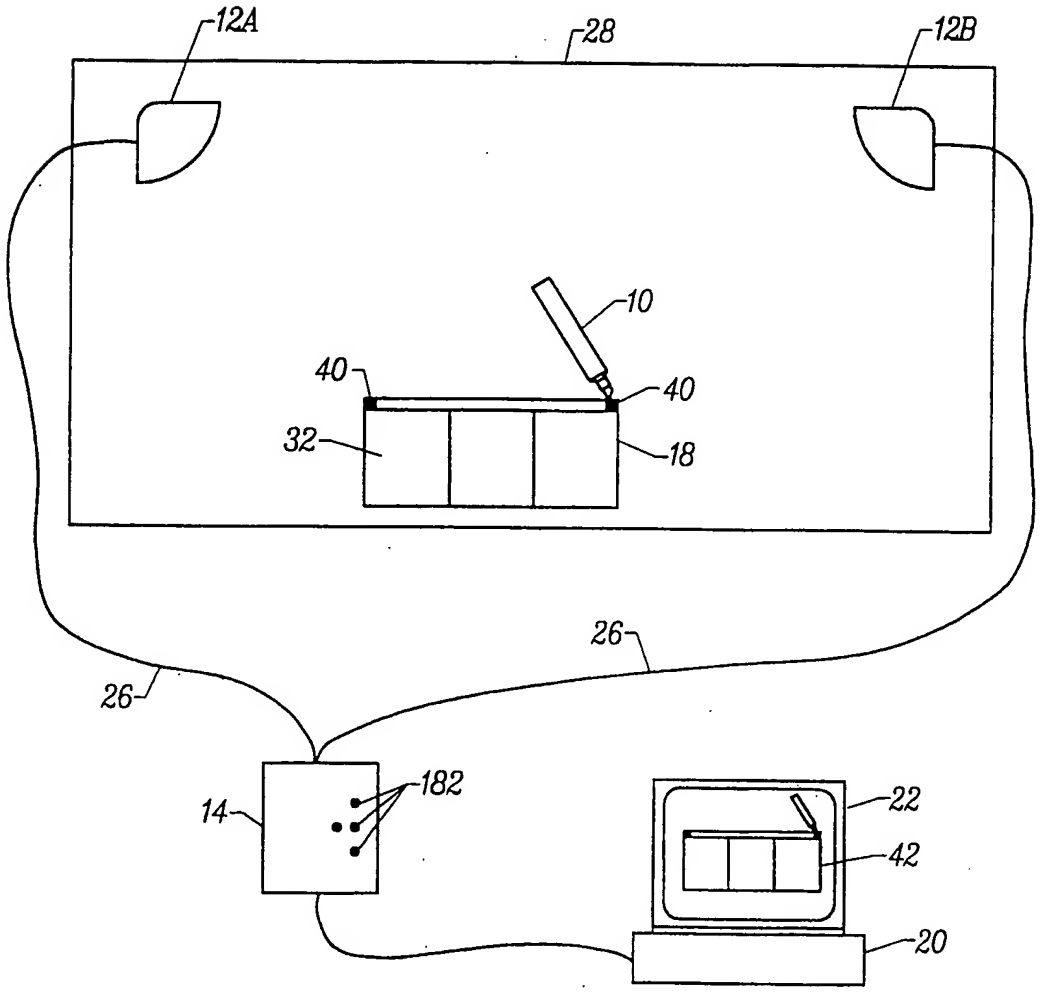

FIG. 1C

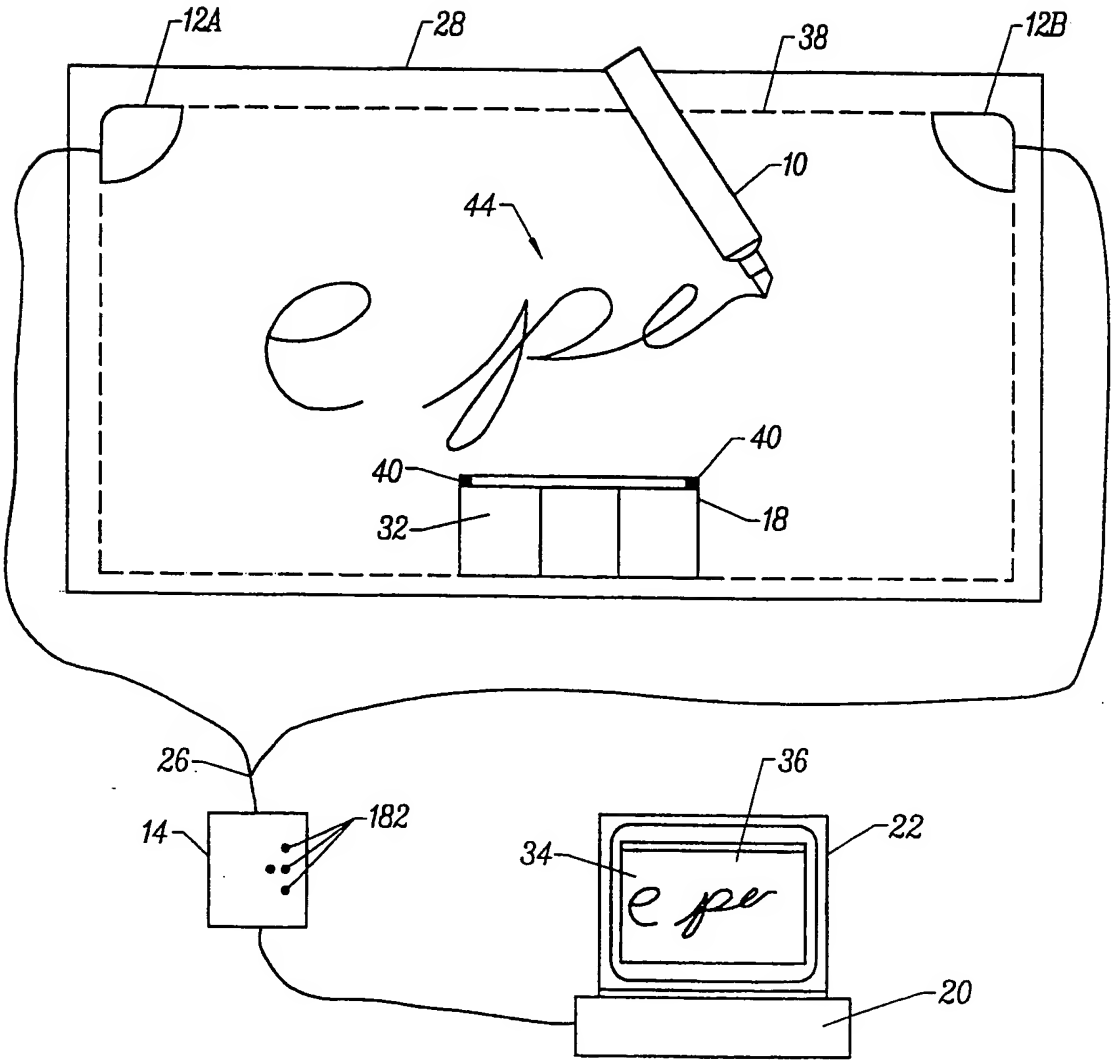

FIG. 1D

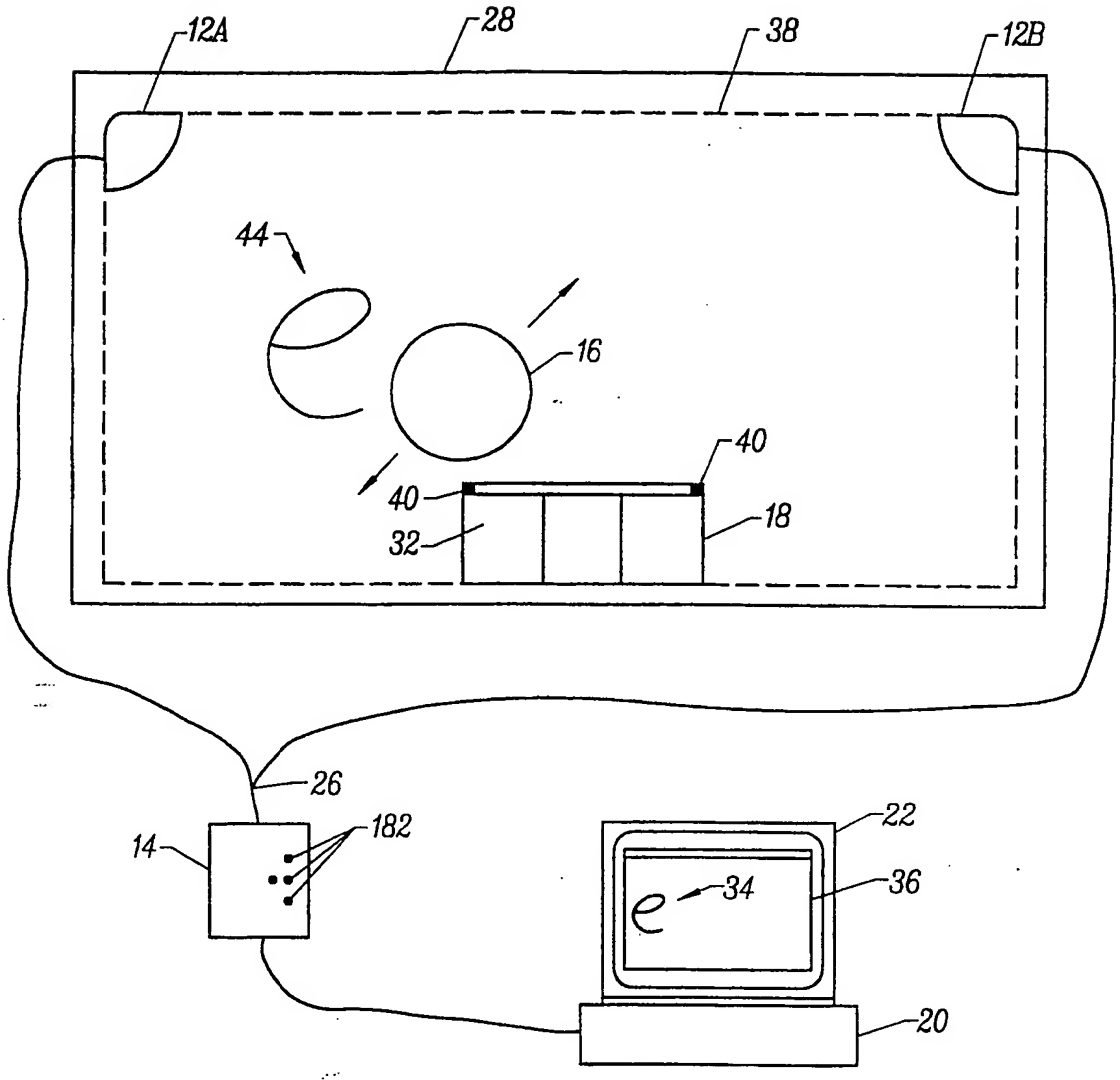

FIG. 1E

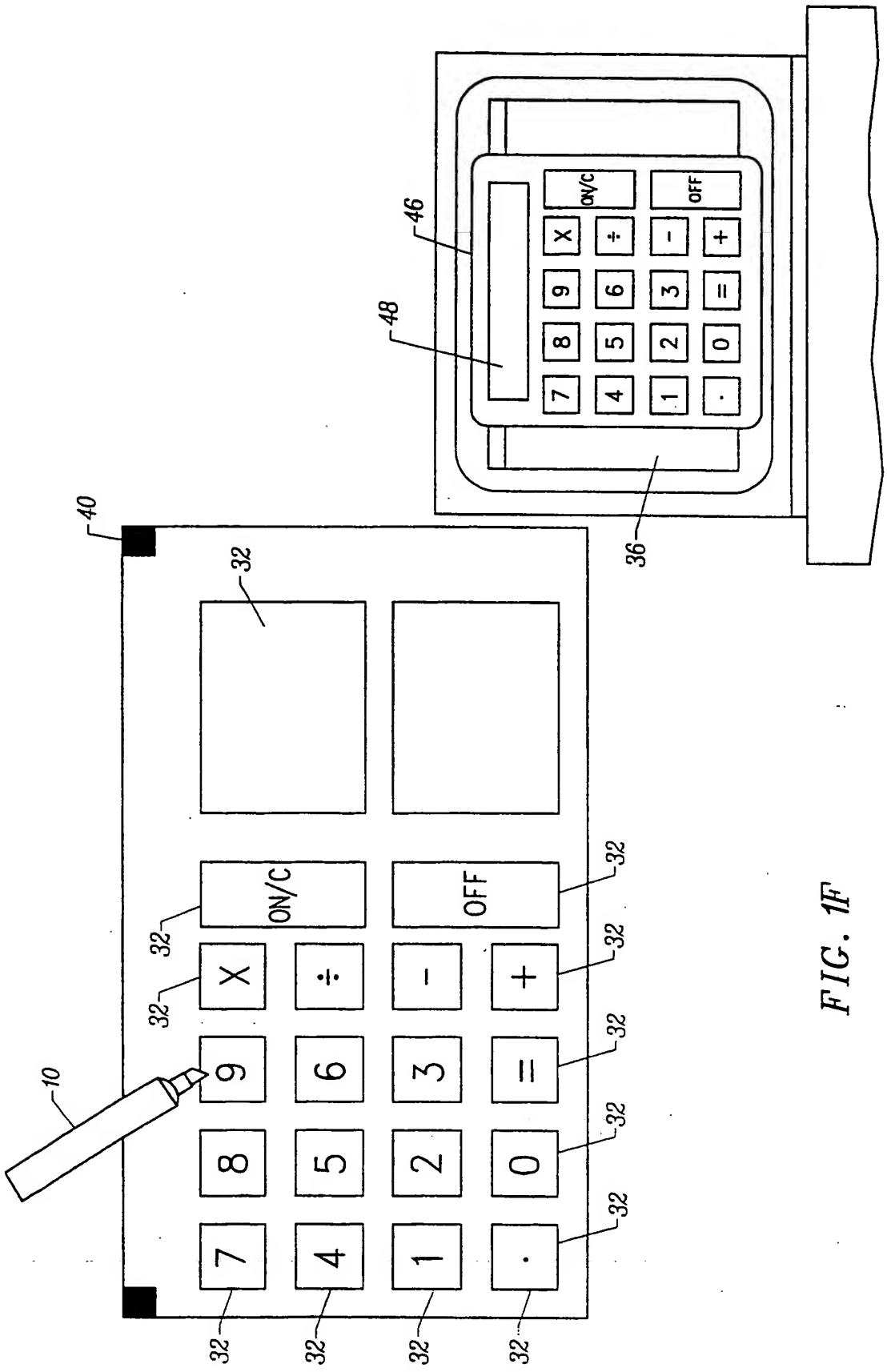

FIG. 1F

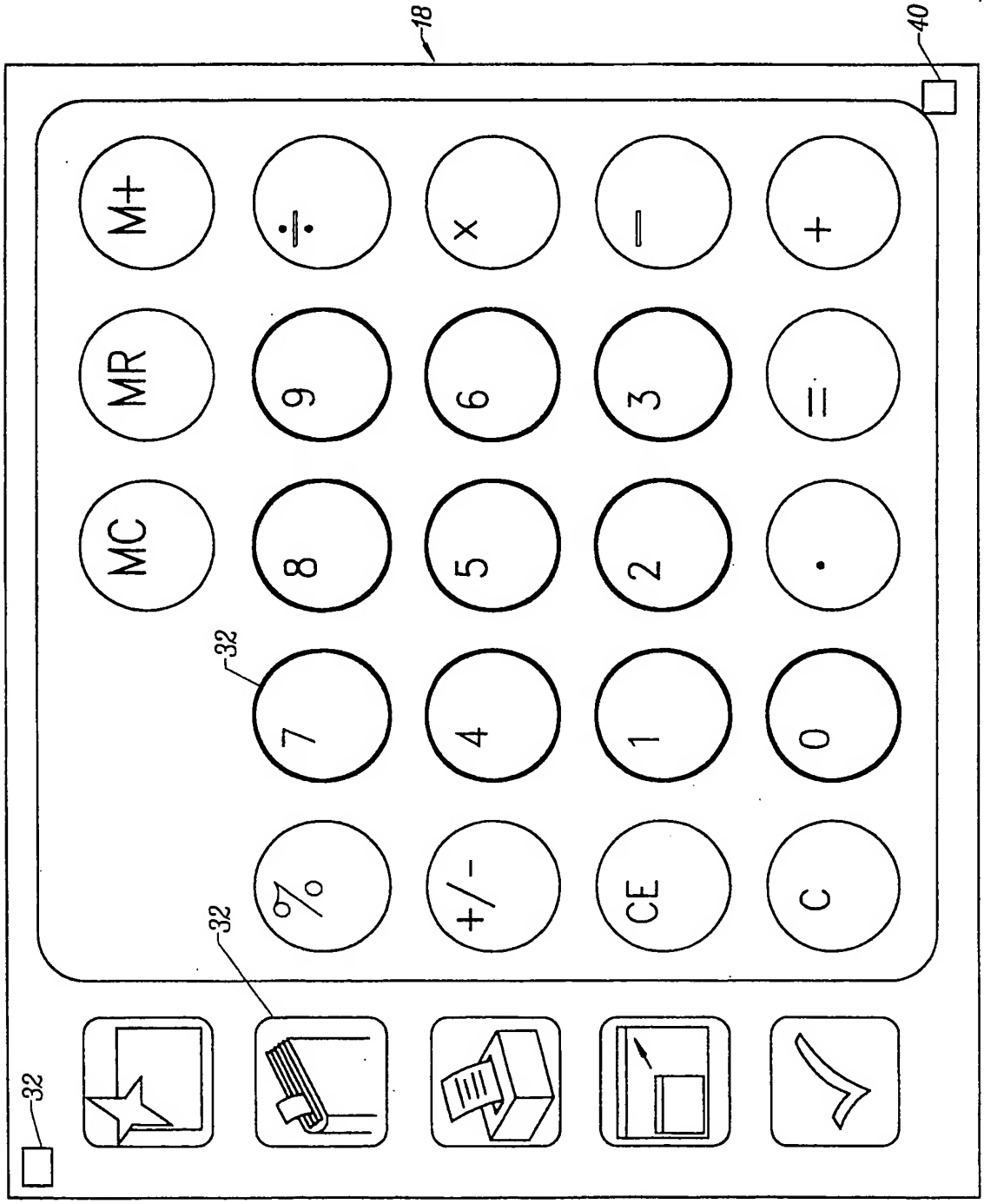

FIG. 1G

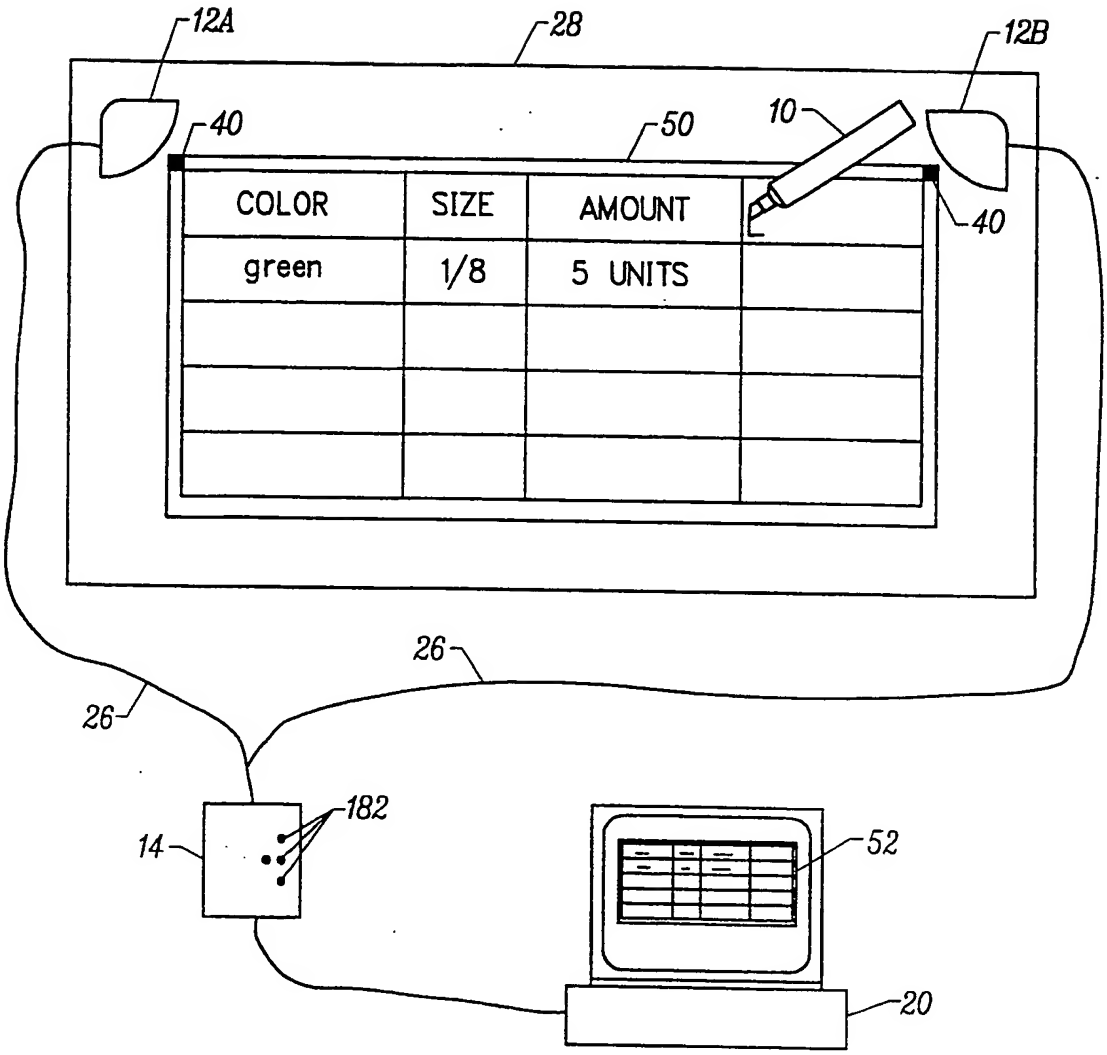
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FIG. 1H

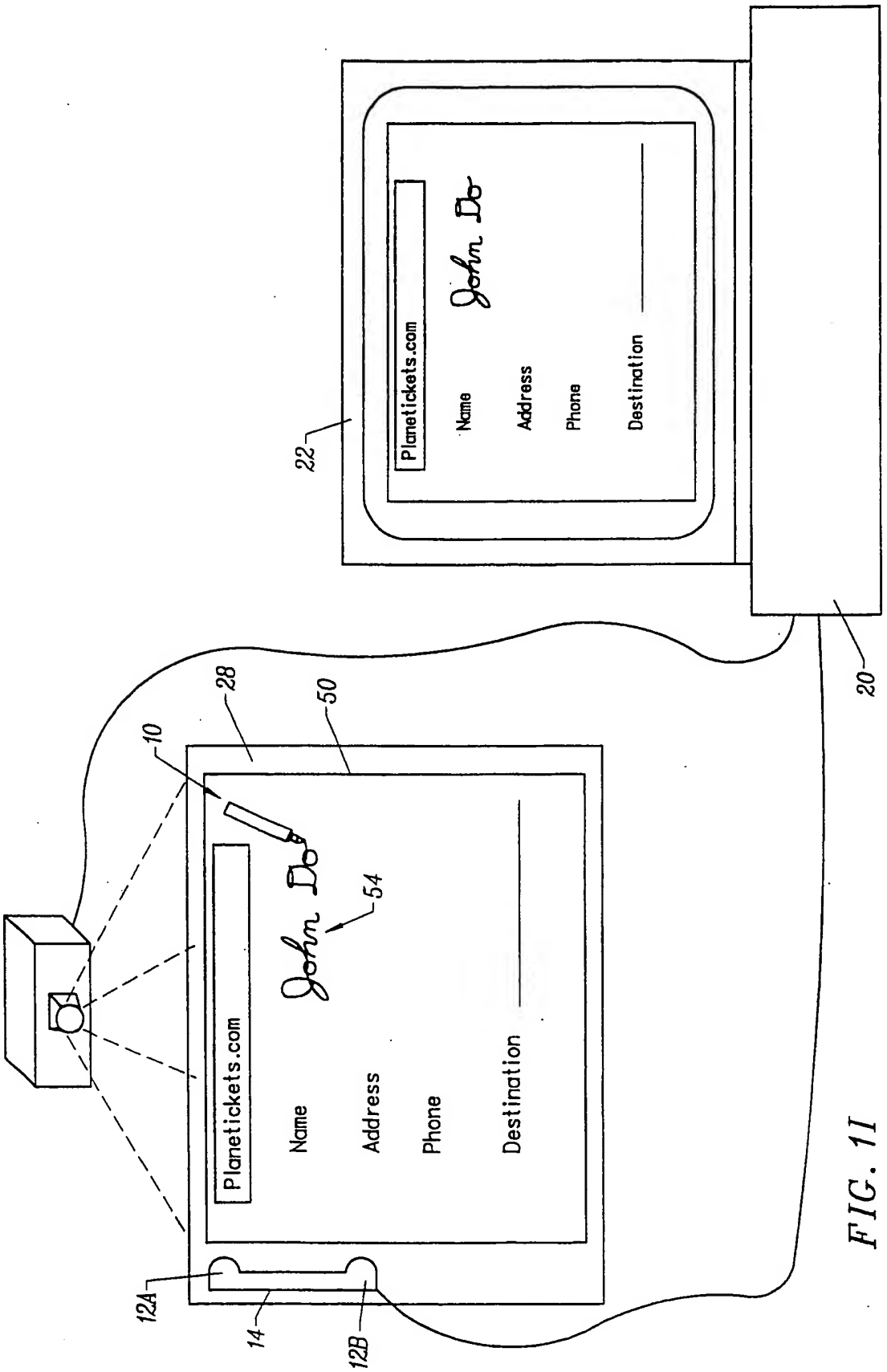
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FIG. 11

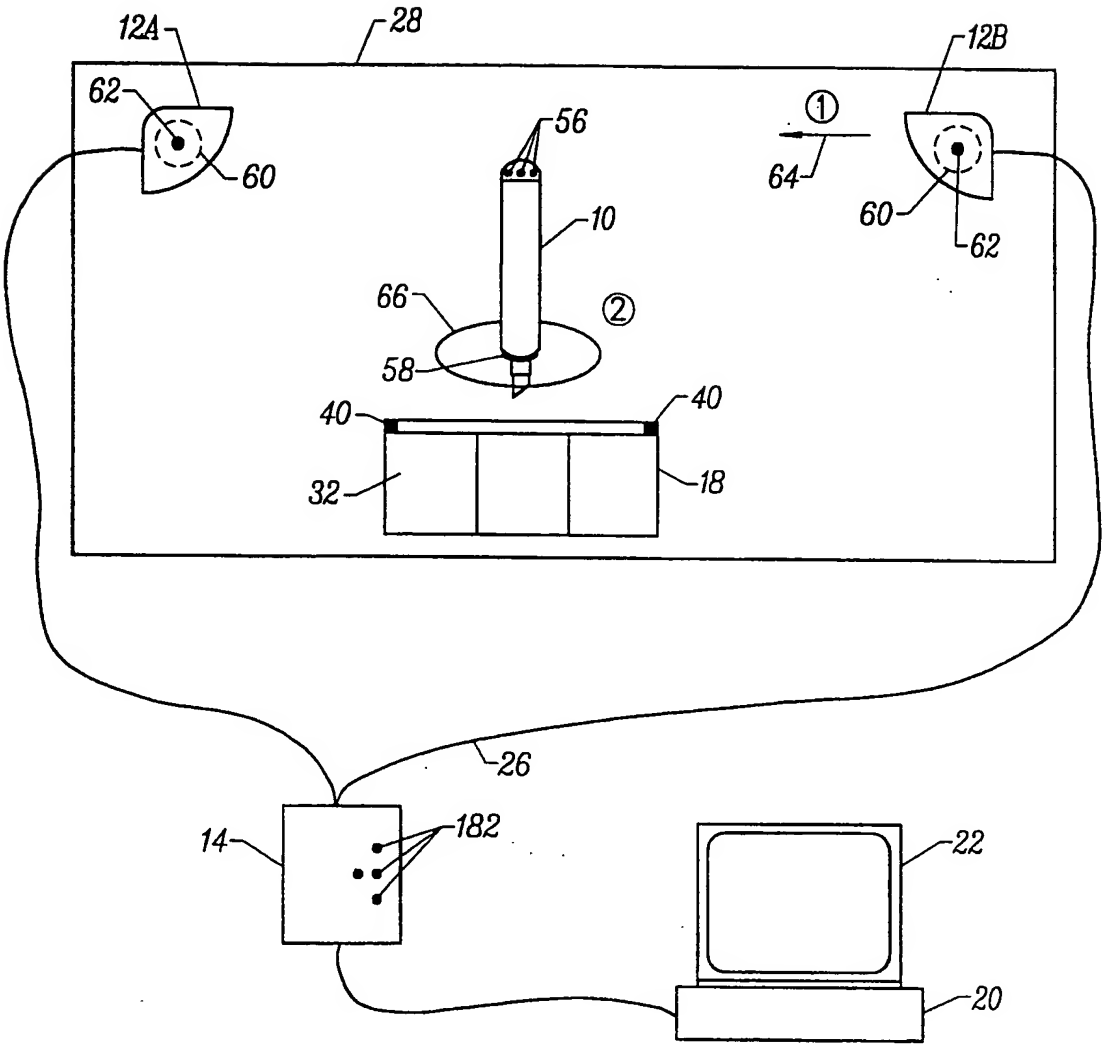


FIG. 2A

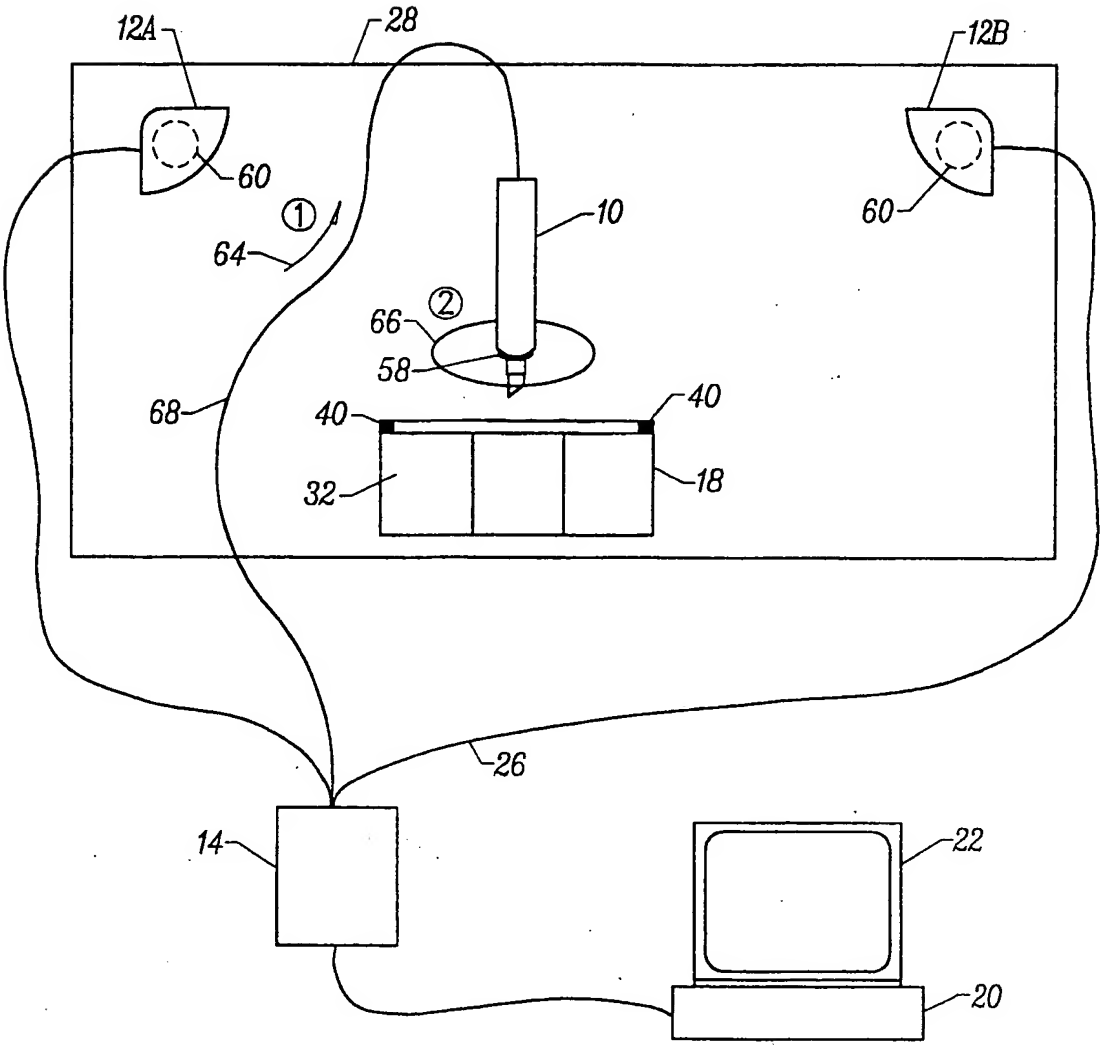


FIG. 2B

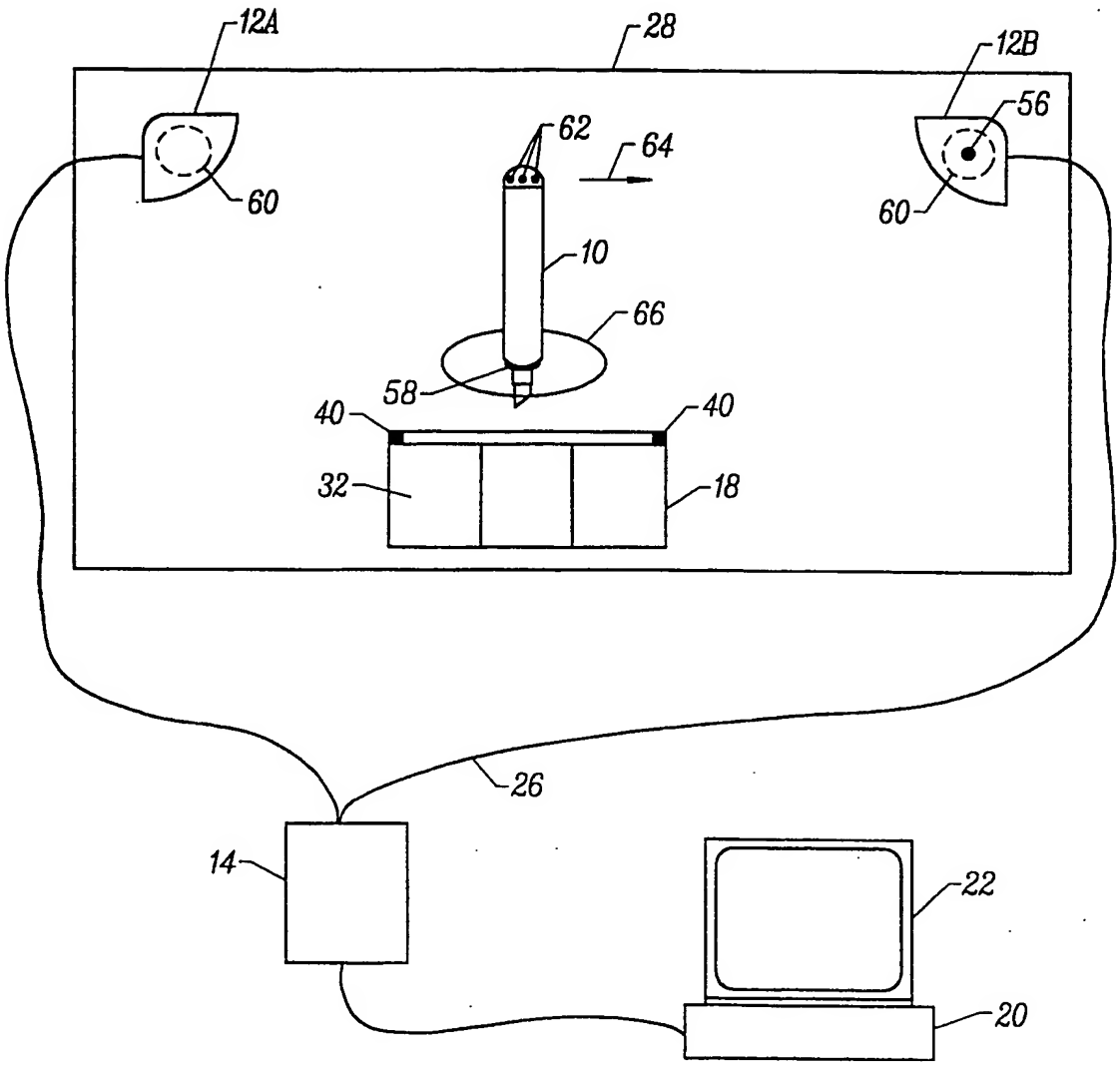


FIG. 2C

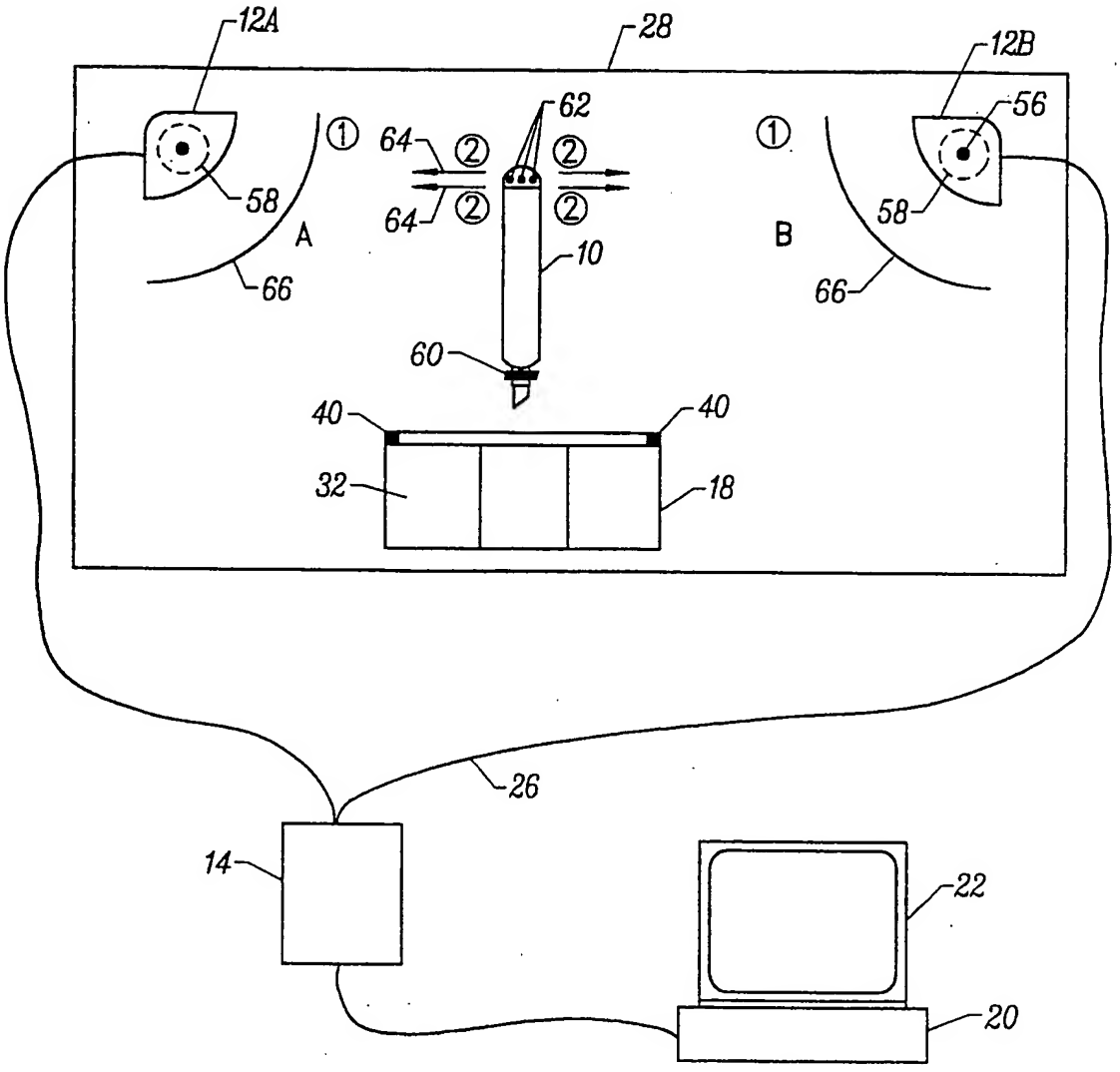


FIG. 2D

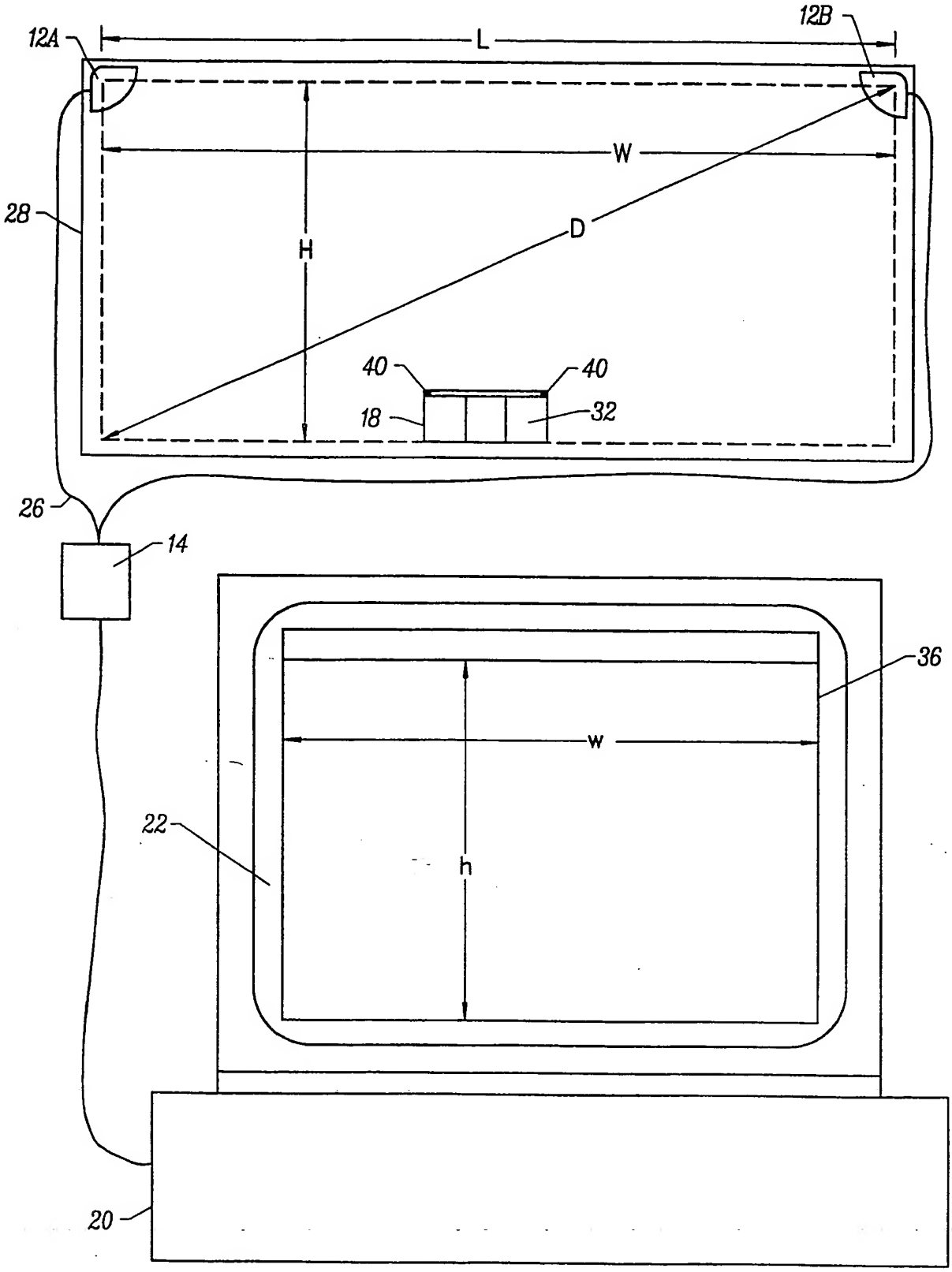


FIG. 3A

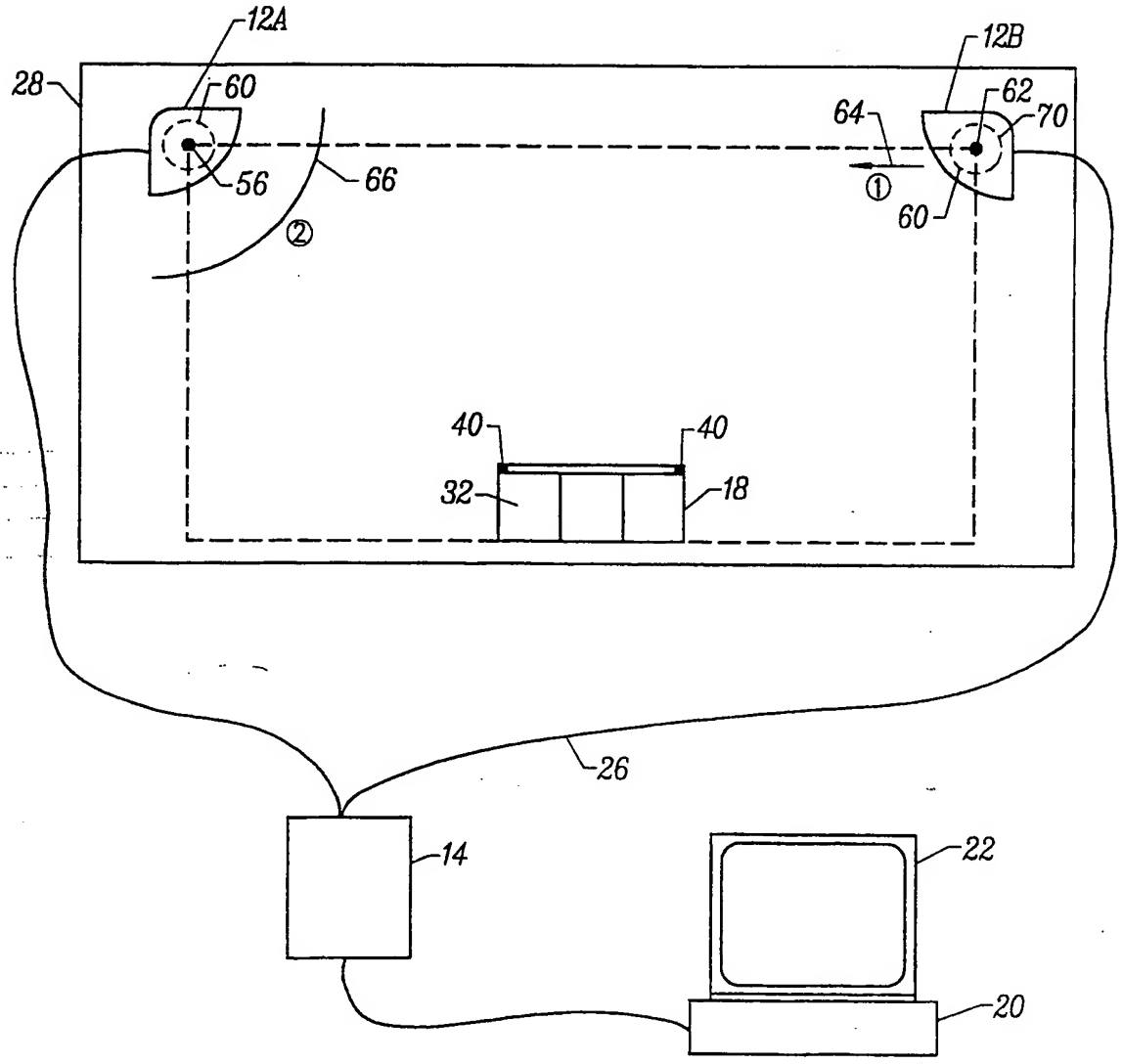


FIG. 3B

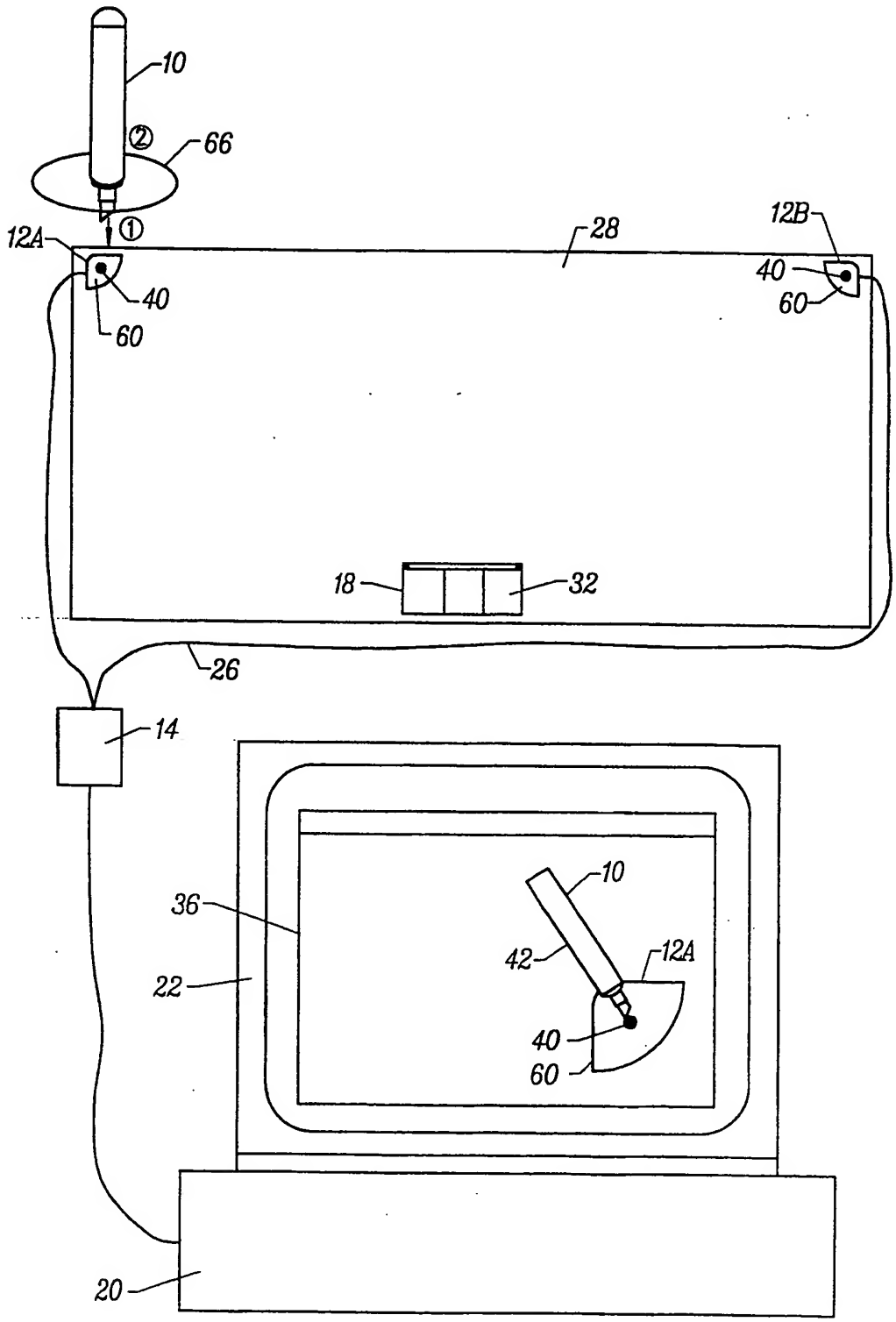


FIG. 3C

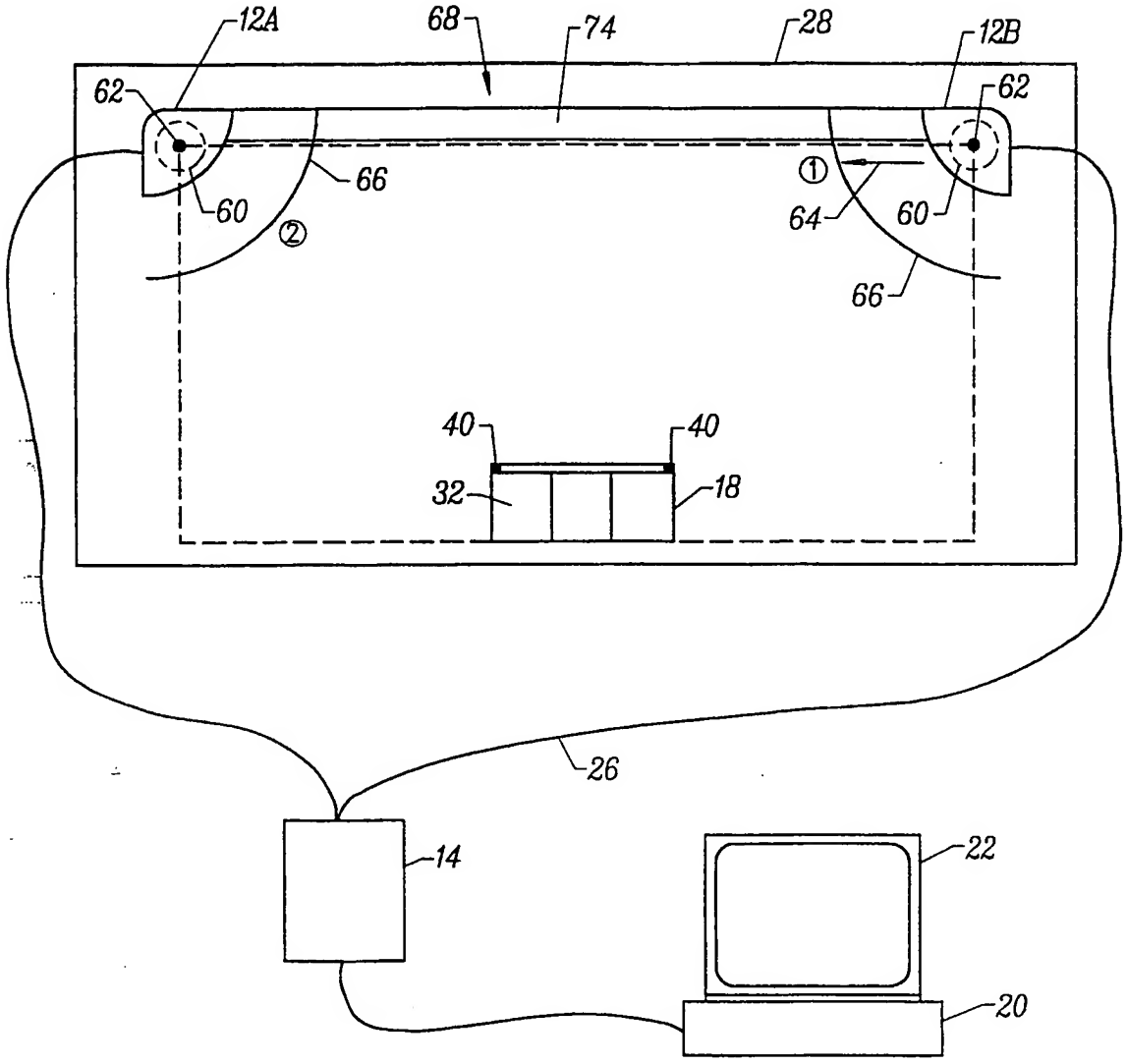


FIG. 3D

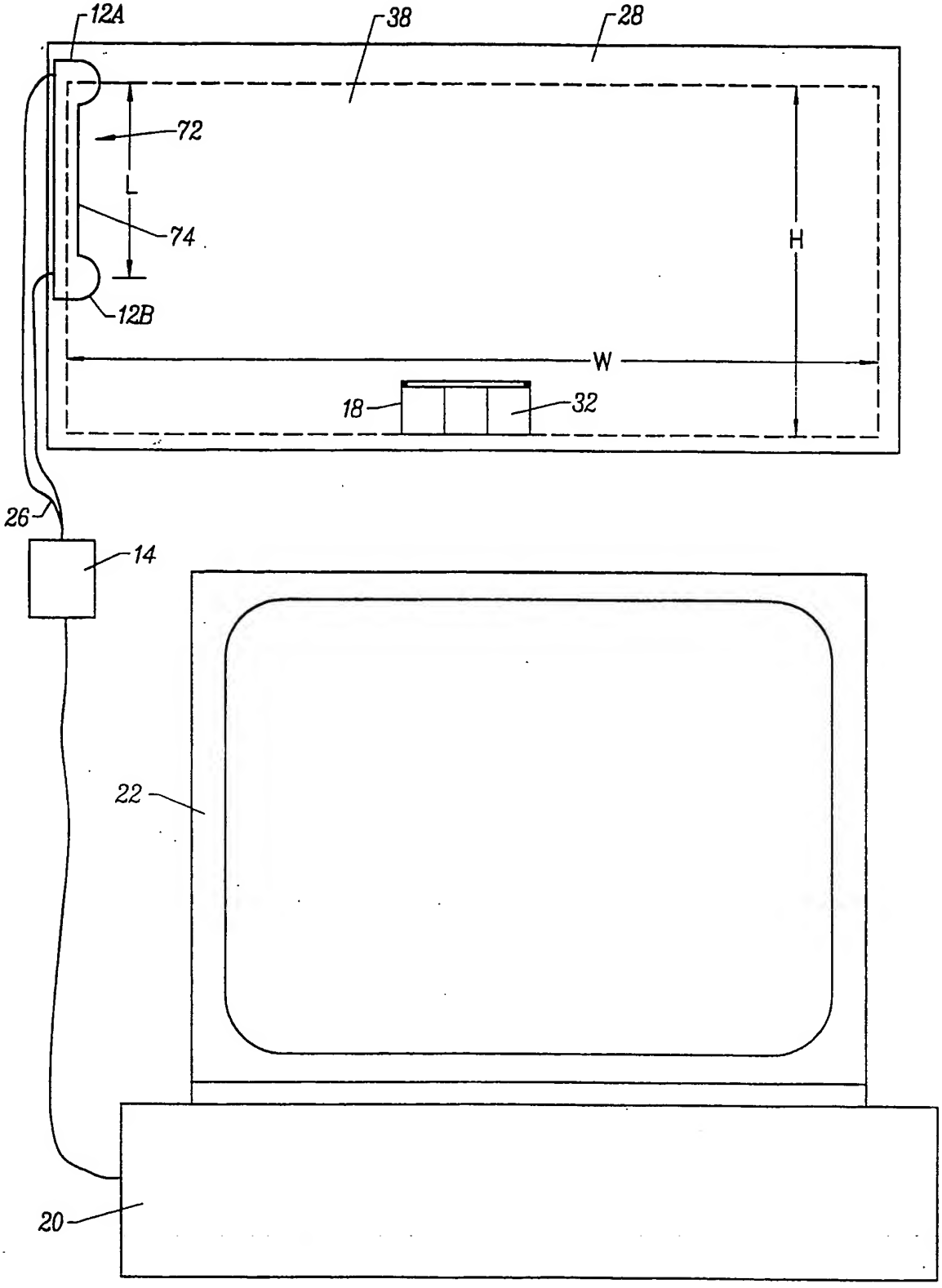
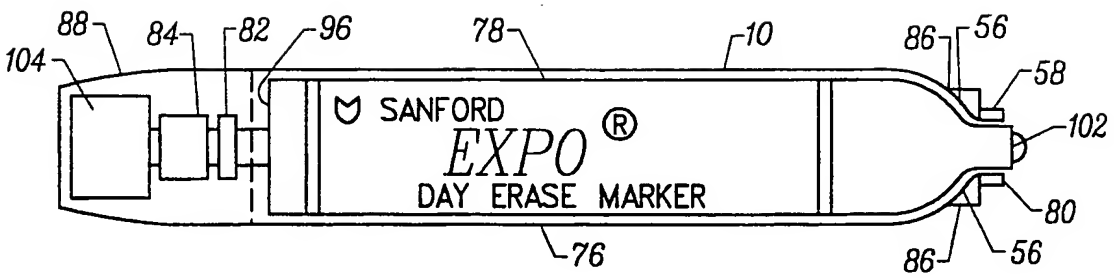


FIG. 3E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EXPO ®
DAY ERASE MARKER
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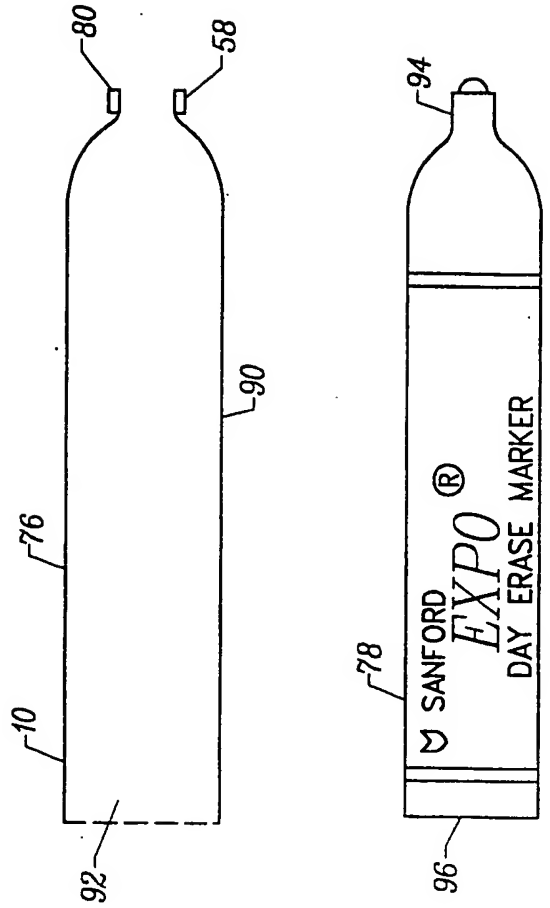
FIG. 4A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EXPO
DAY ERASE MARKER
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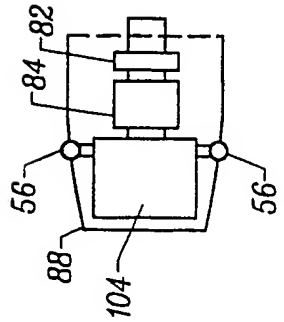
FIG. 4B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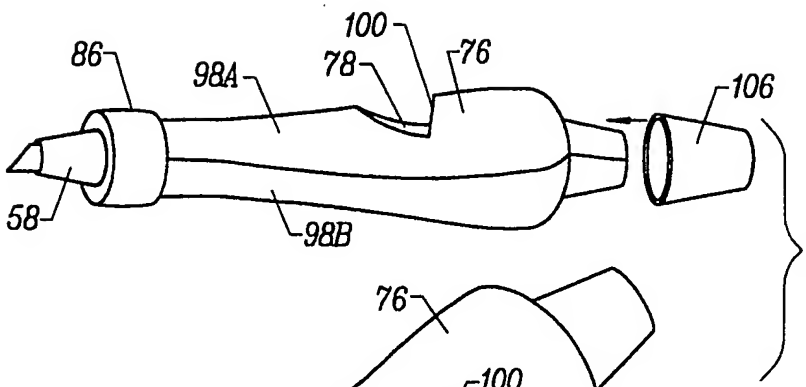
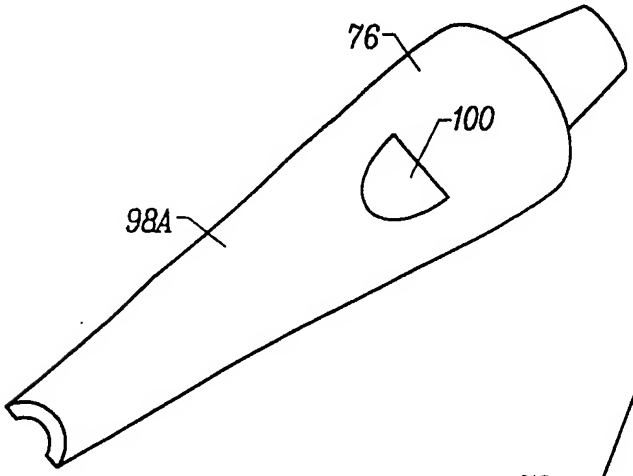


FIG. 4D



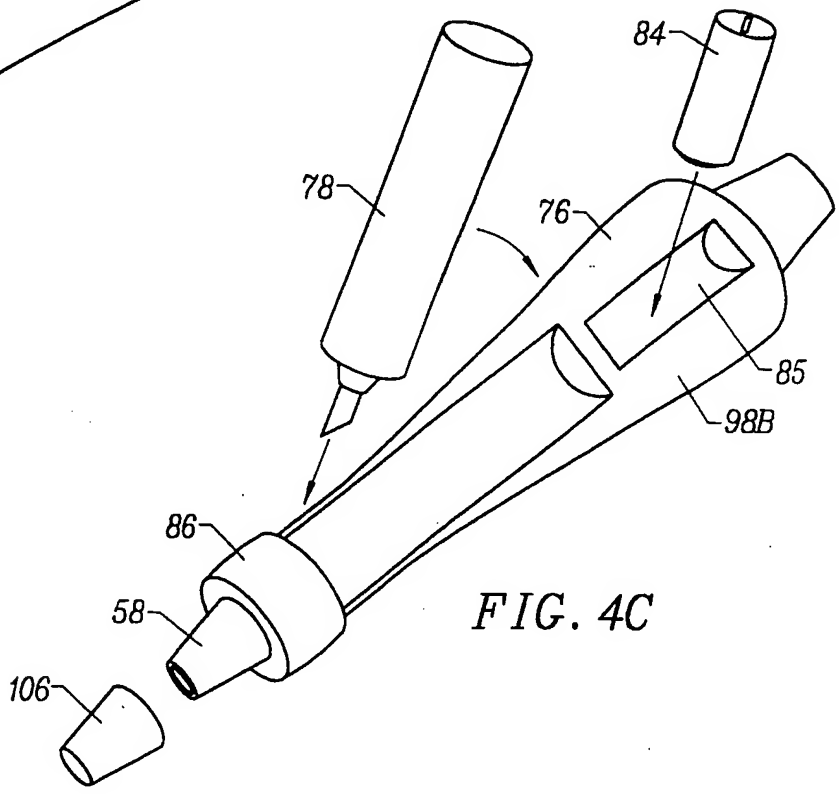


FIG. 4C

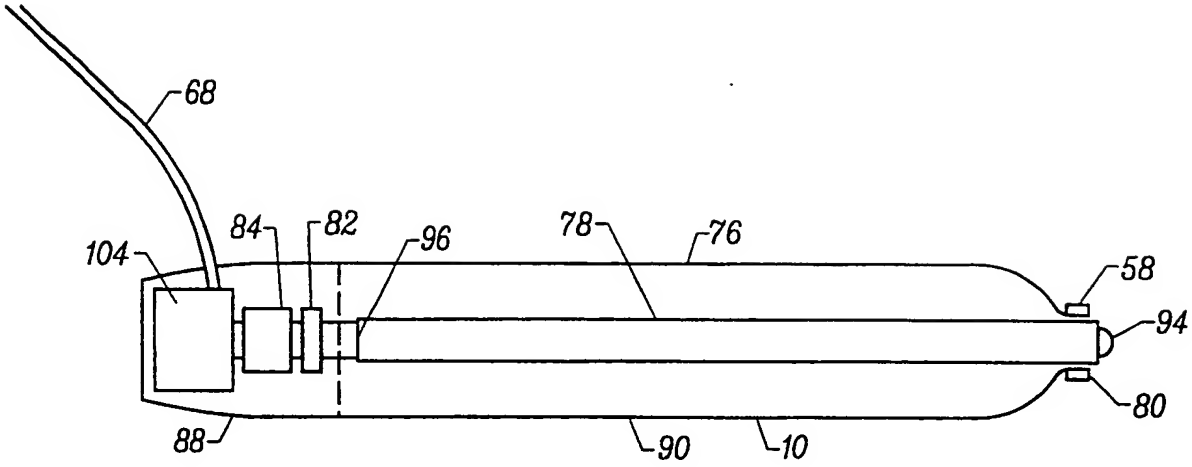


FIG. 4E

FIG. 4F

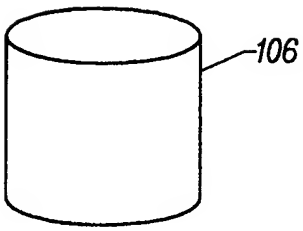
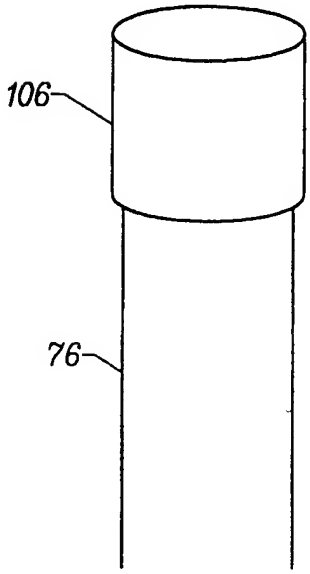


FIG. 4G



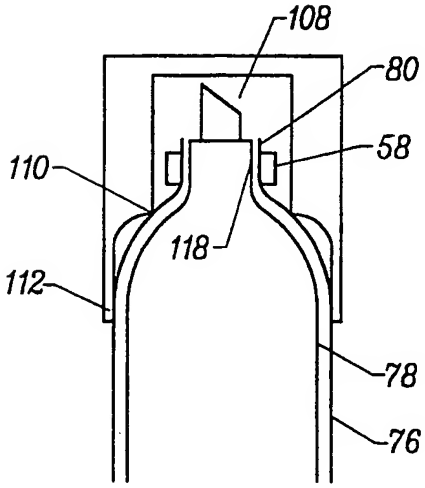


FIG. 4H

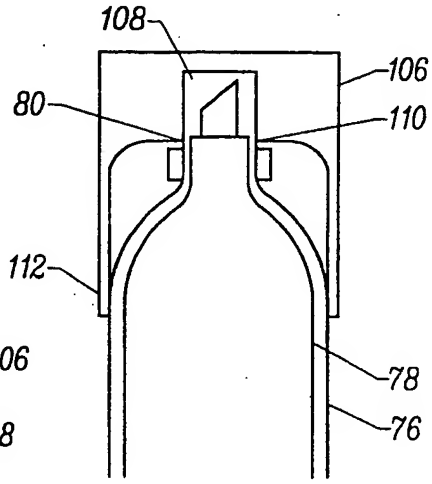


FIG. 4I

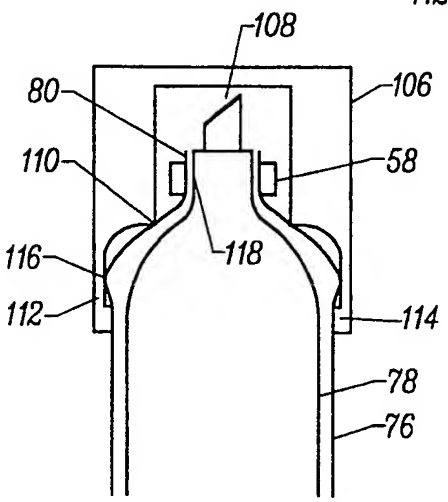


FIG. 4J

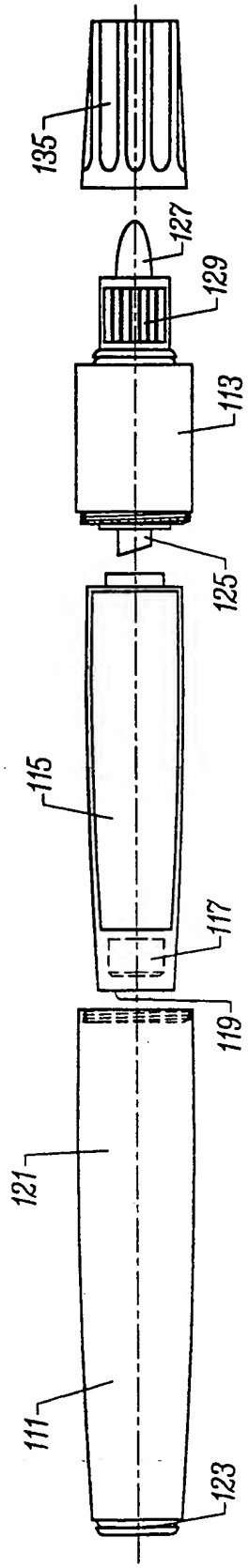

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FIG. 4K

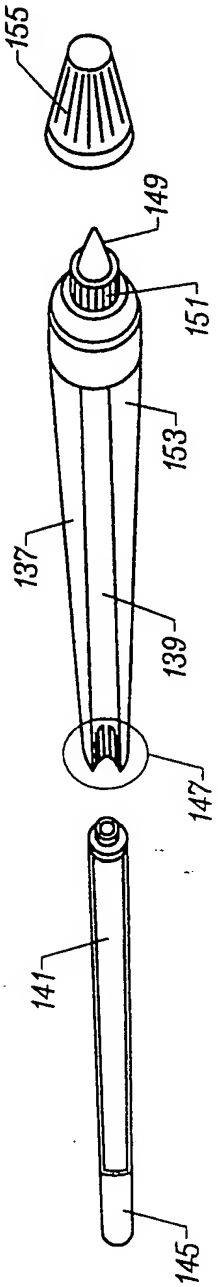
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FIG. 4L

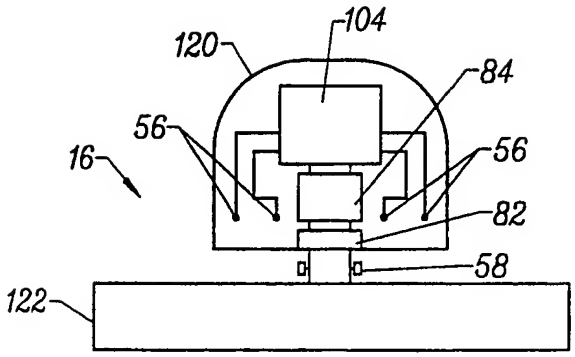


FIG. 5A

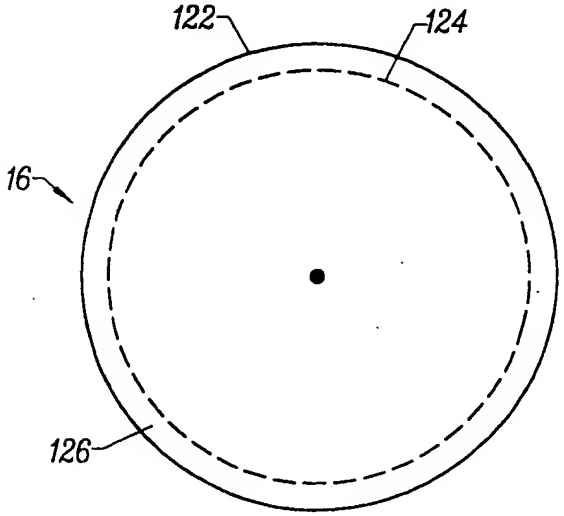


FIG. 5B

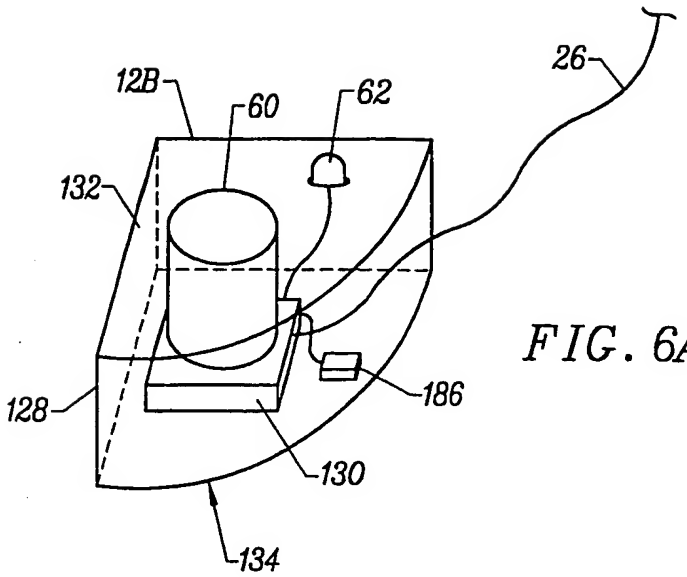


FIG. 6A

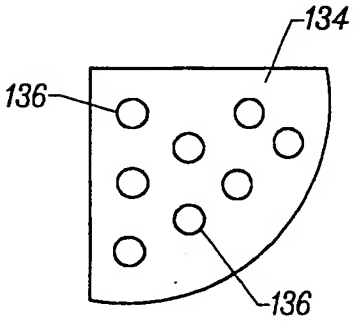


FIG. 6B

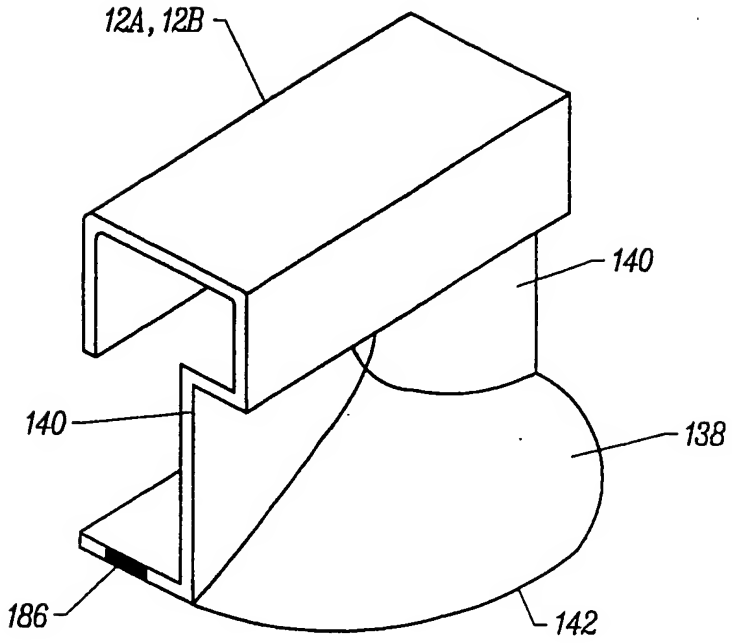


FIG. 7A

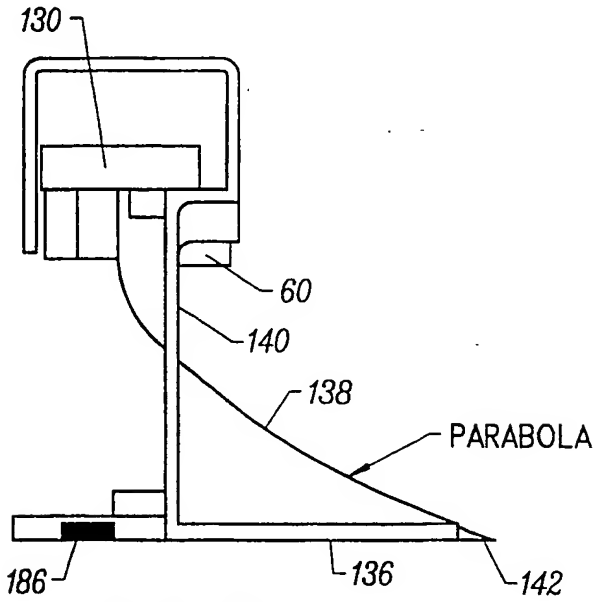


FIG. 7B

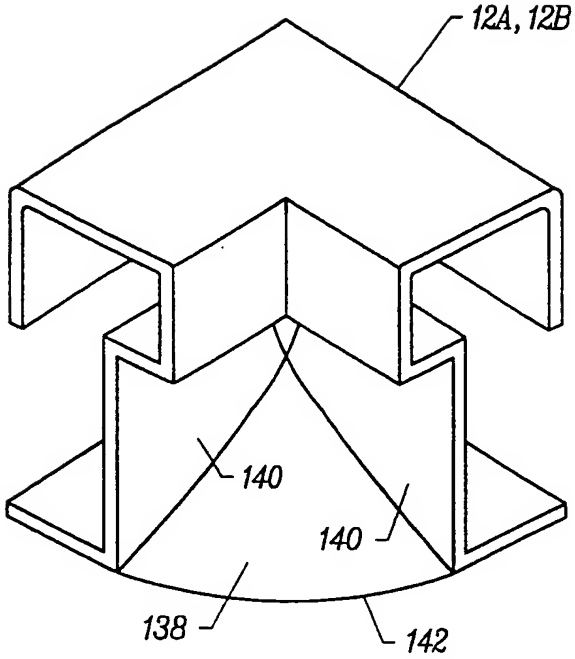


FIG. 7C

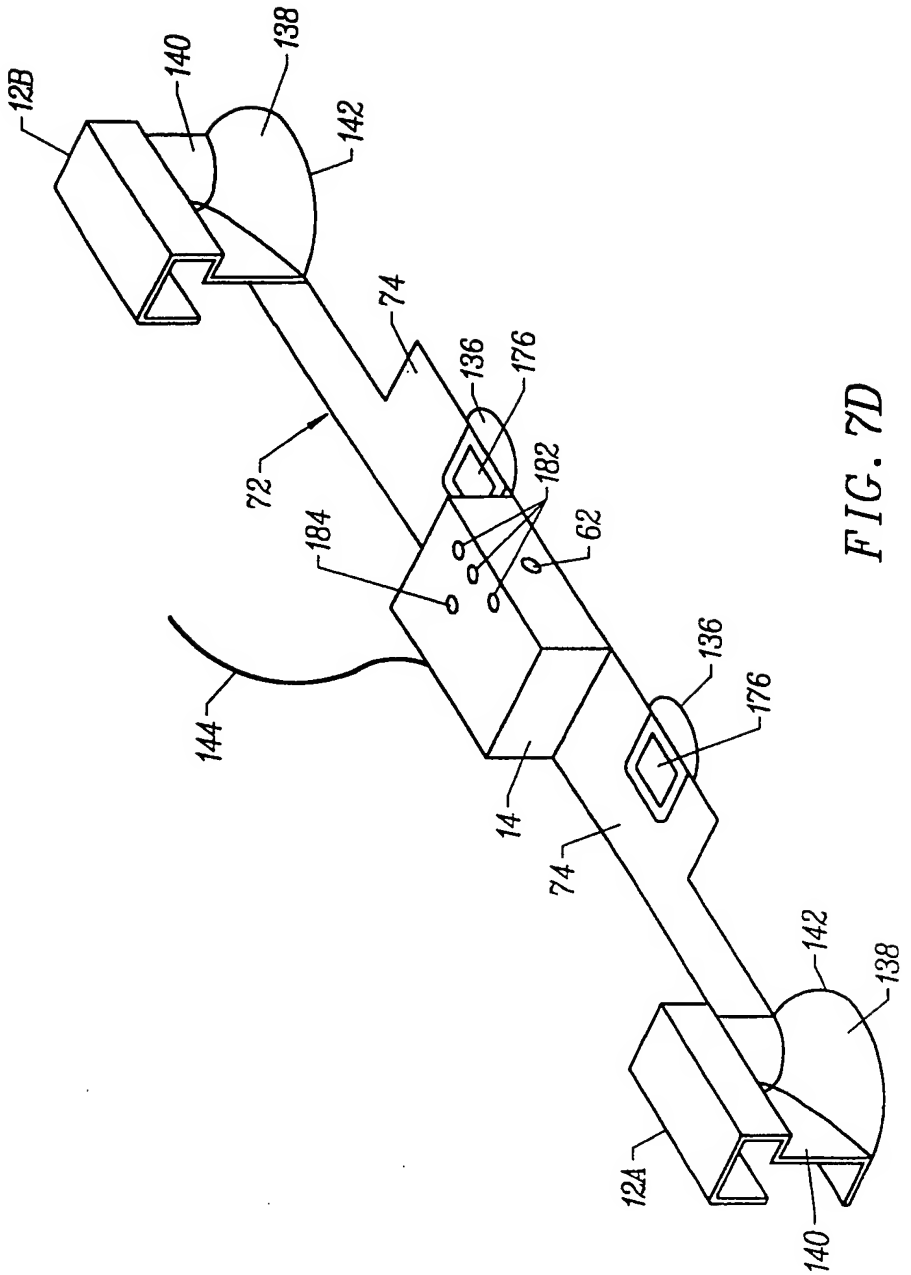

12B
140
138
142
74
136
176
72
182
184
62
144
14
136
176
74
142
138
12A
140

FIG. 7D

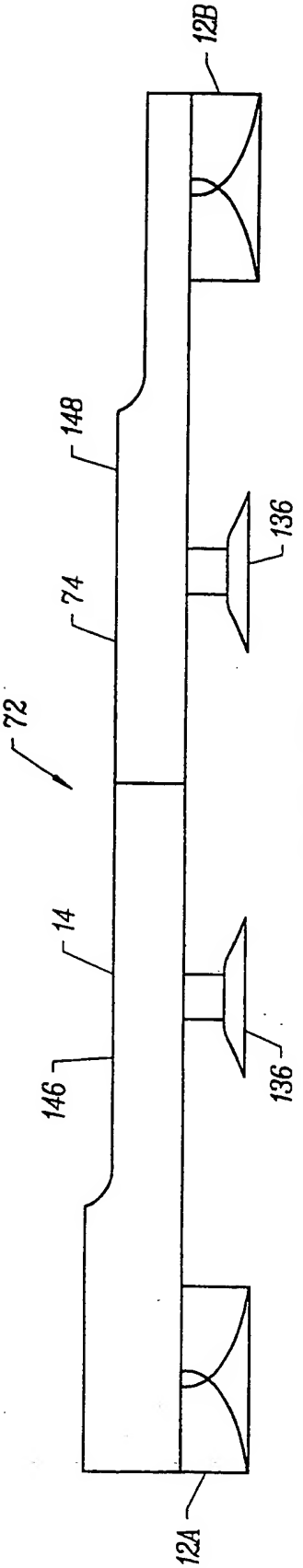

12B
148
136
74
72
14
146
136
12A

FIG. 7E

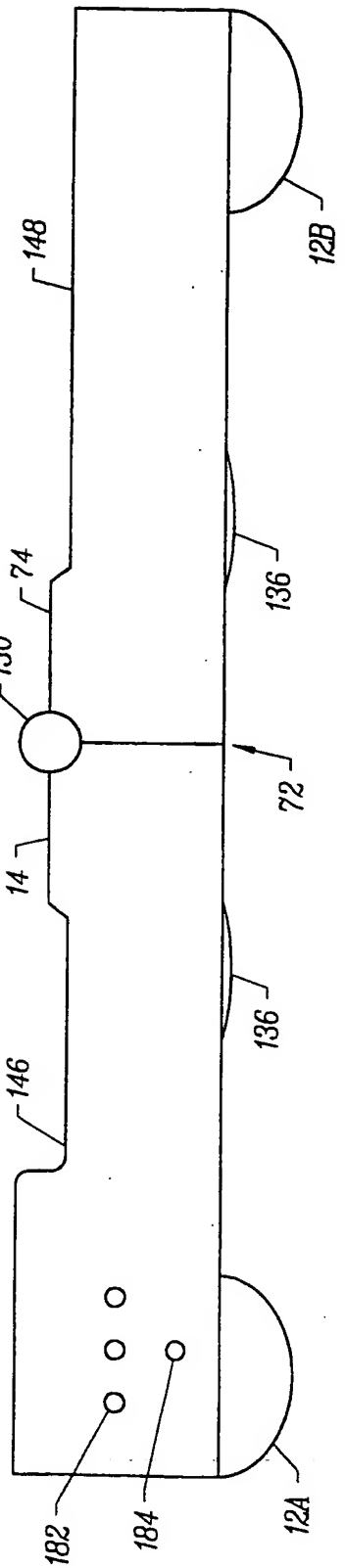

148
12B
74
136
150
72
14
136
146
182
184
12A

FIG. 7F

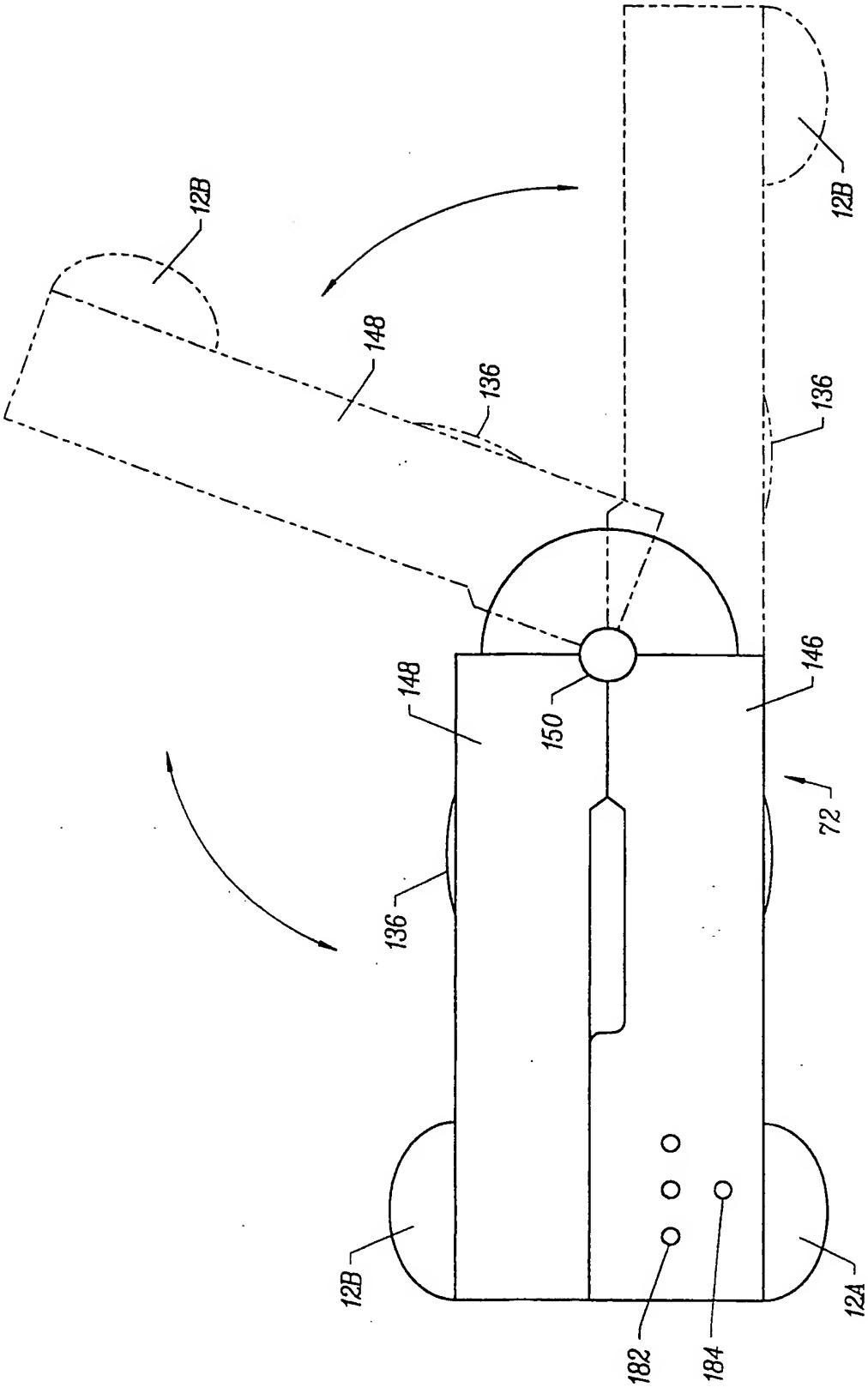


FIG. 7G

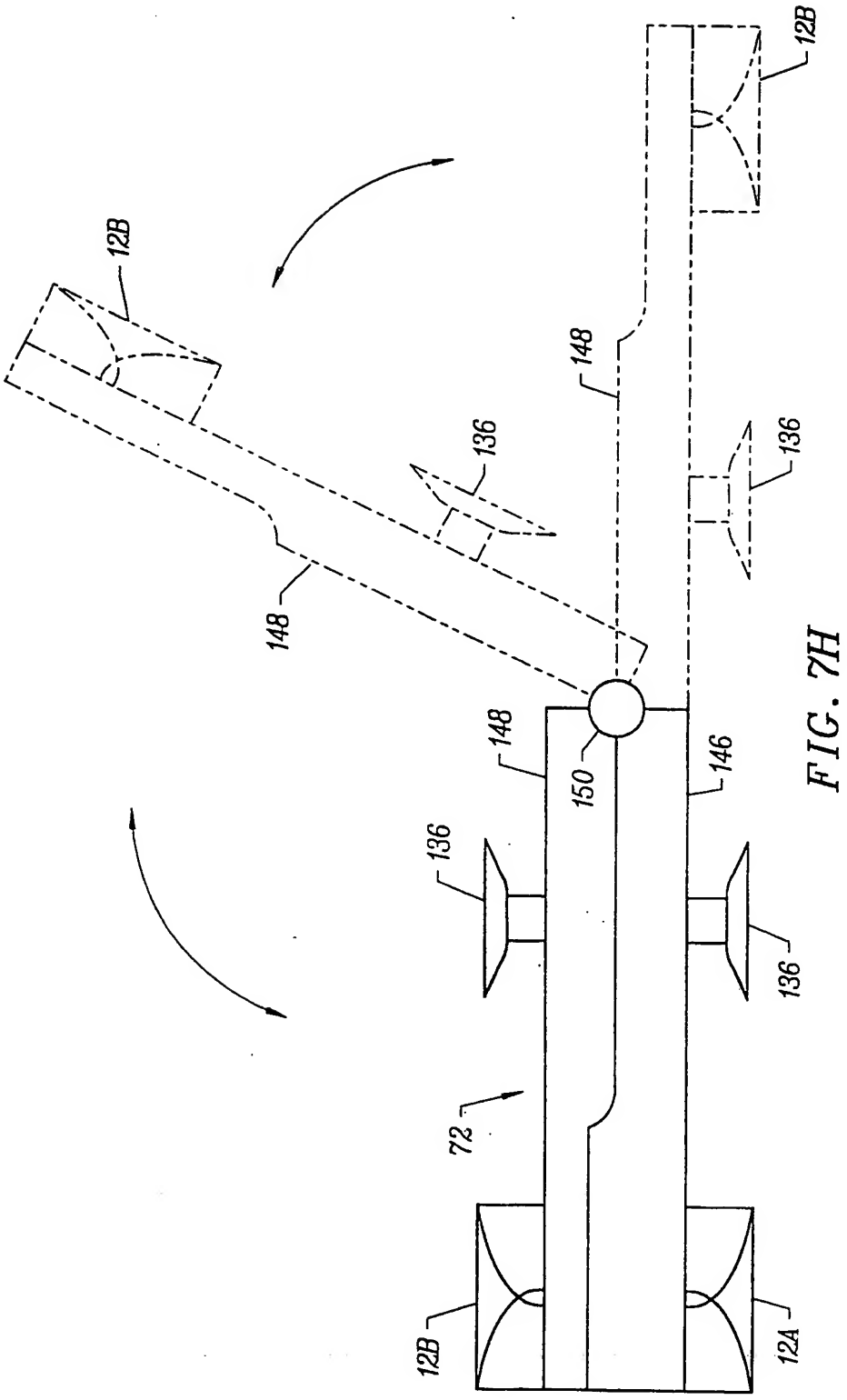


FIG. 7H

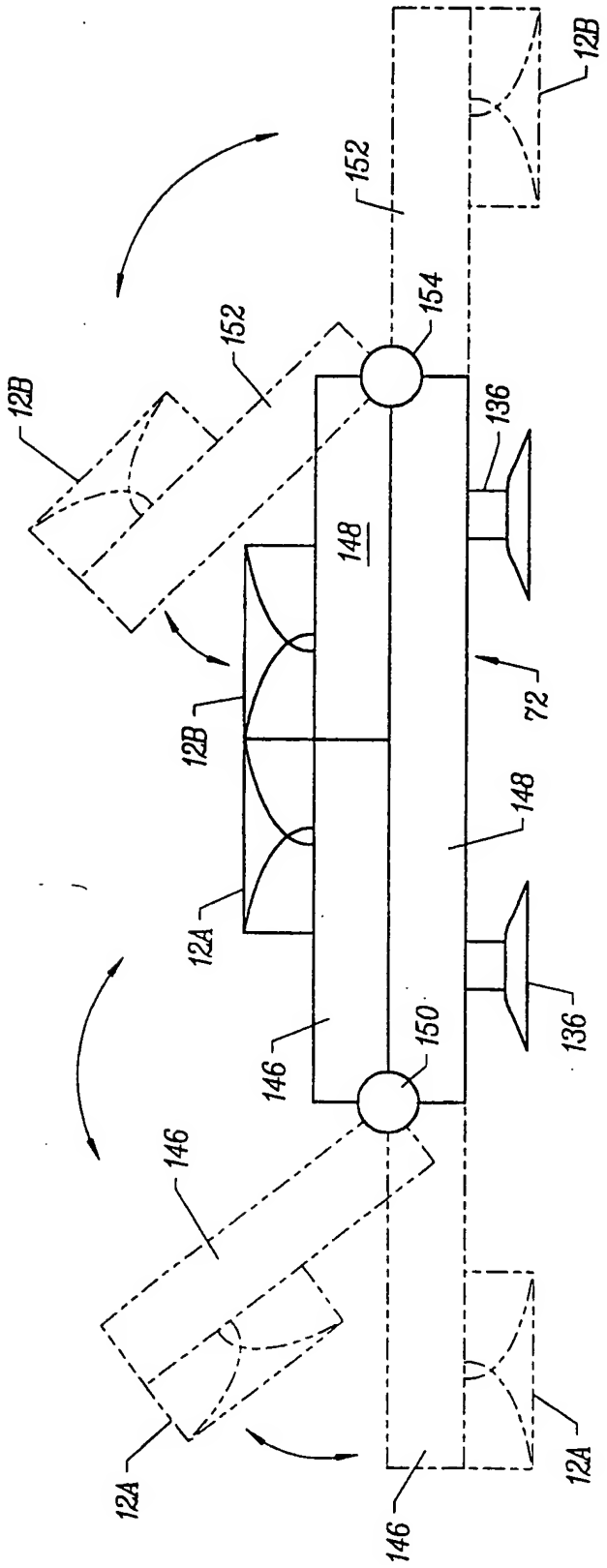

12B
152
154
152
12B
136
148
72
12B
148
12A
136
146
150
146
12A
146
12A

FIG. 71

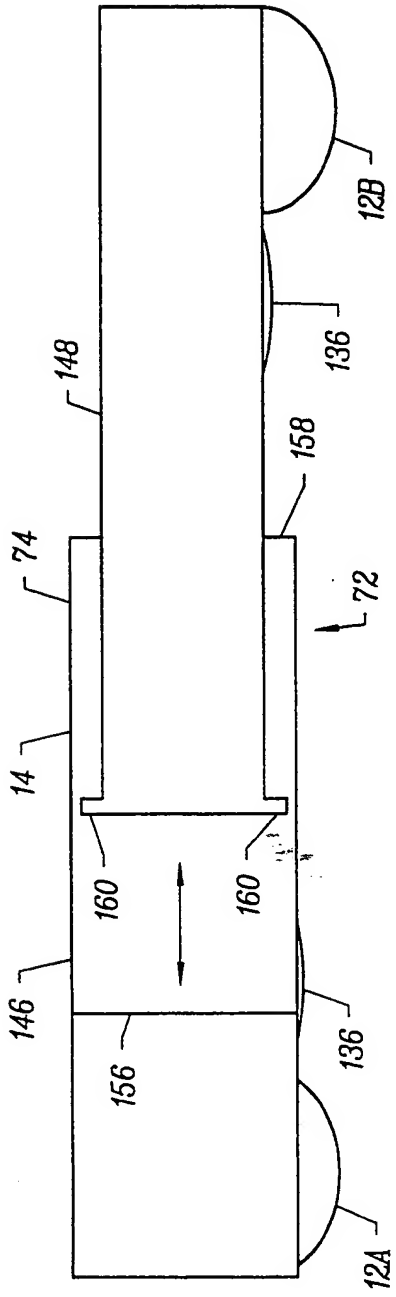

12B
136
148
158
74
72
14
160
160
146
136
156
12A

FIG. 7K

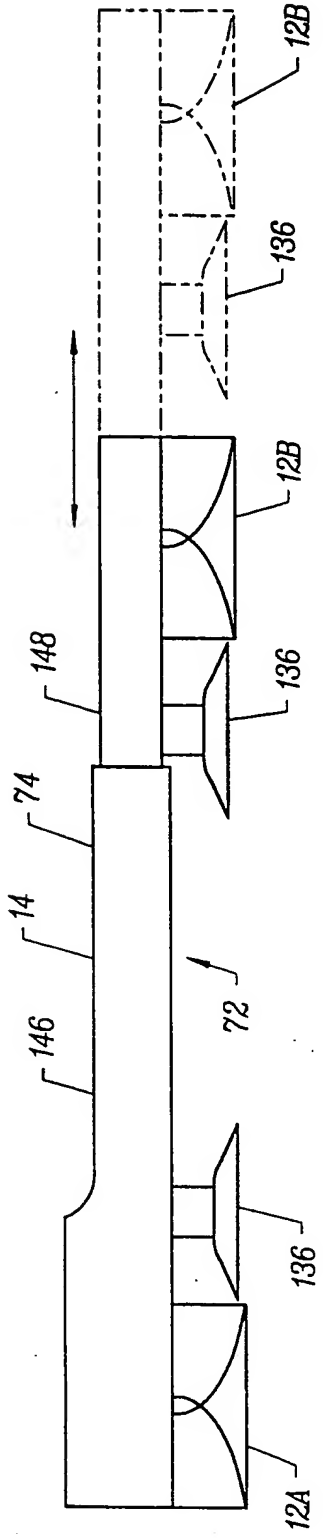

12B
136
12B
148
136
74
14
72
146
136
12A

FIG. 7J

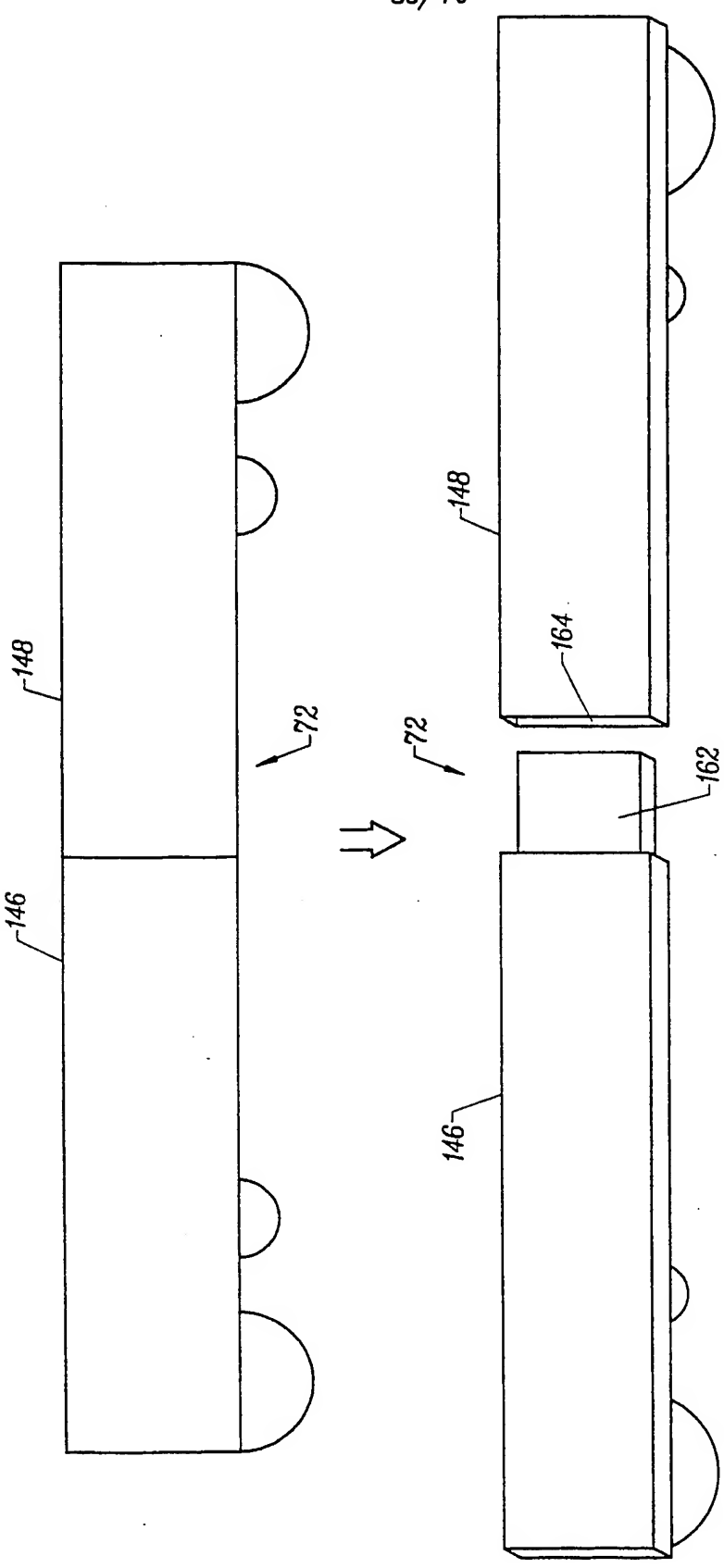


FIG. 7L

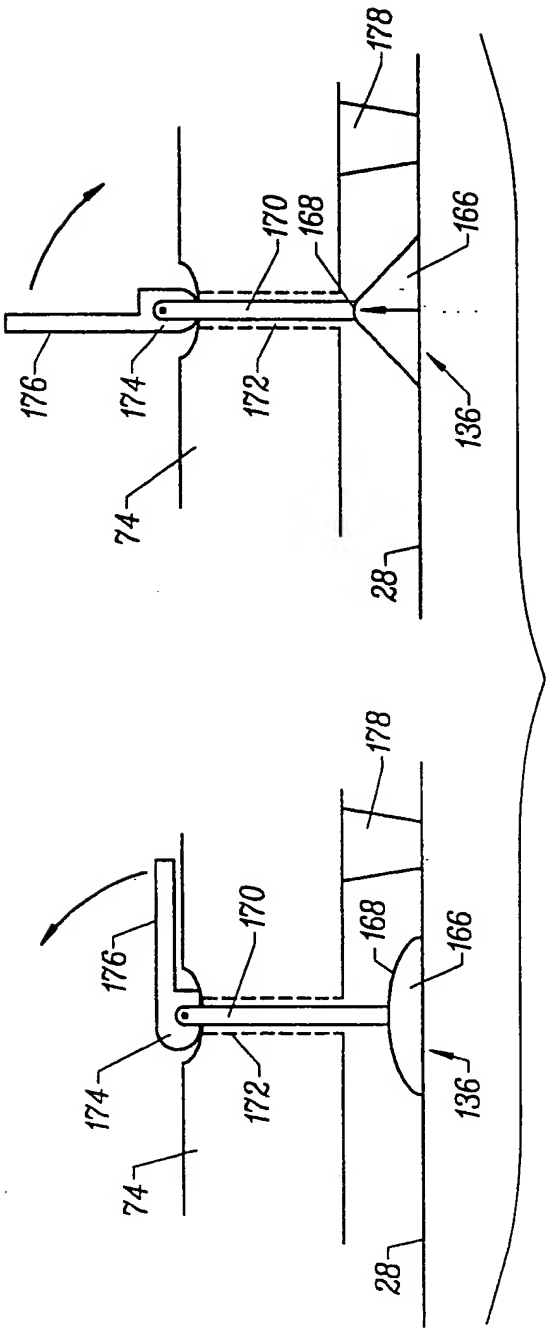

178
170
168
166
176
174
172
136
74
28
178
170
168
166
176
174
172
136
74
28

FIG. 7M

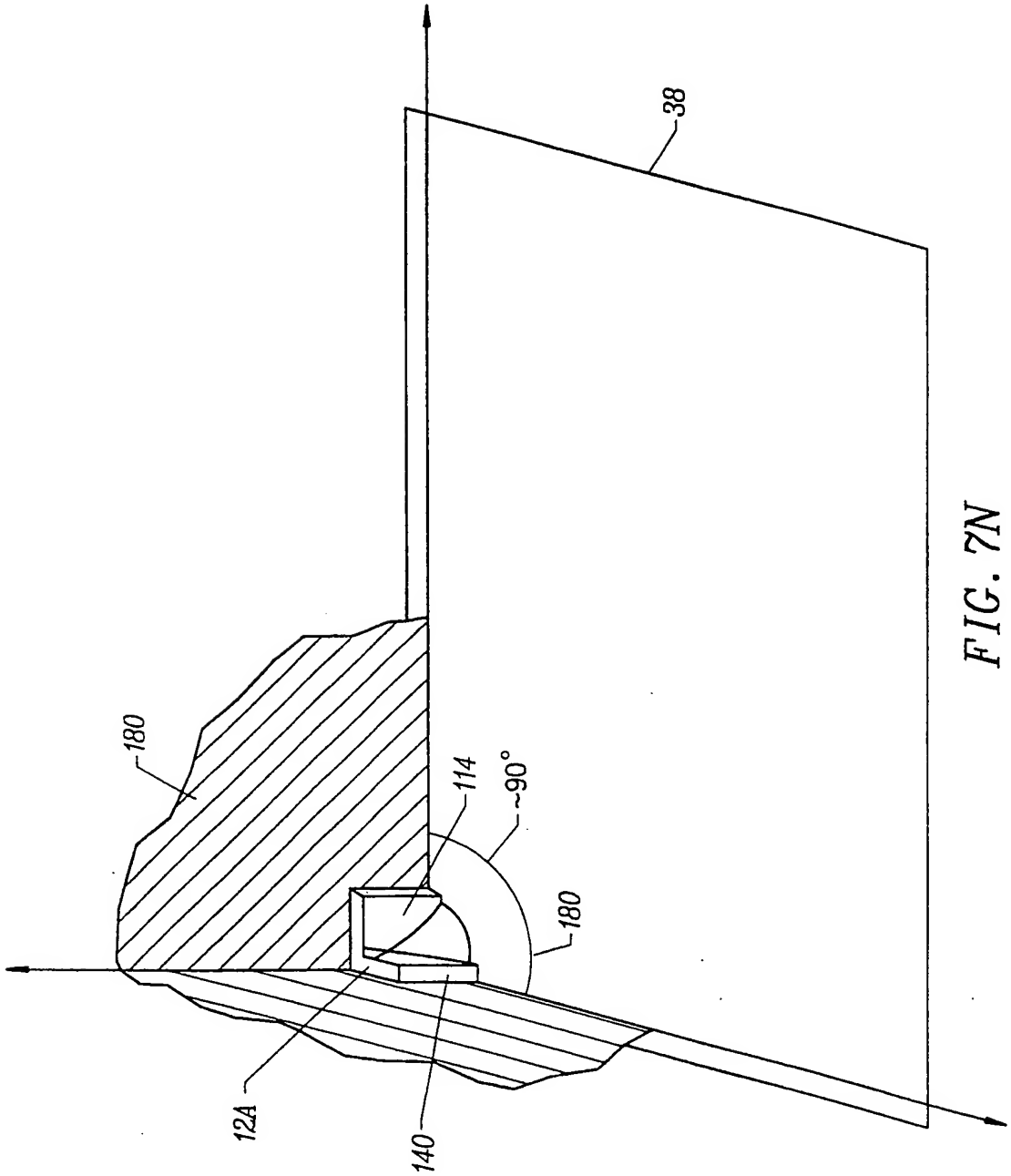


FIG. 7N

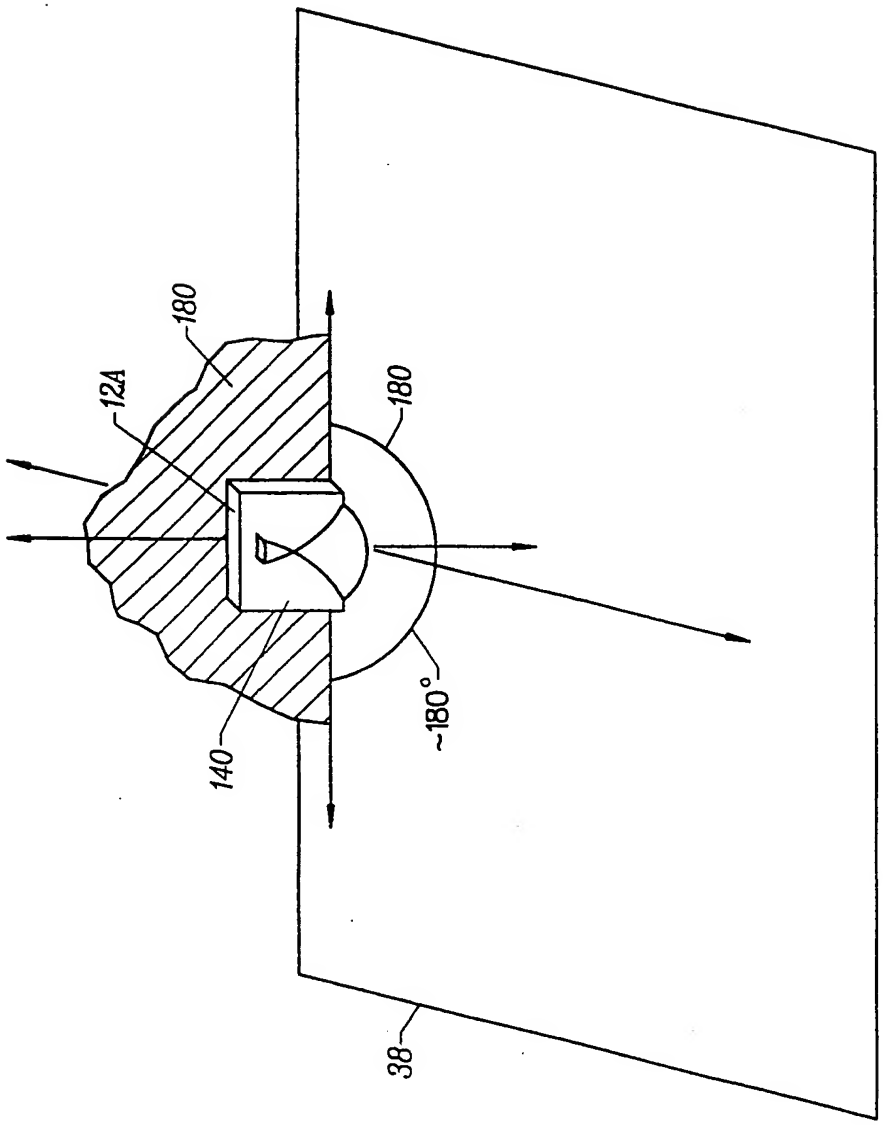


FIG. 70

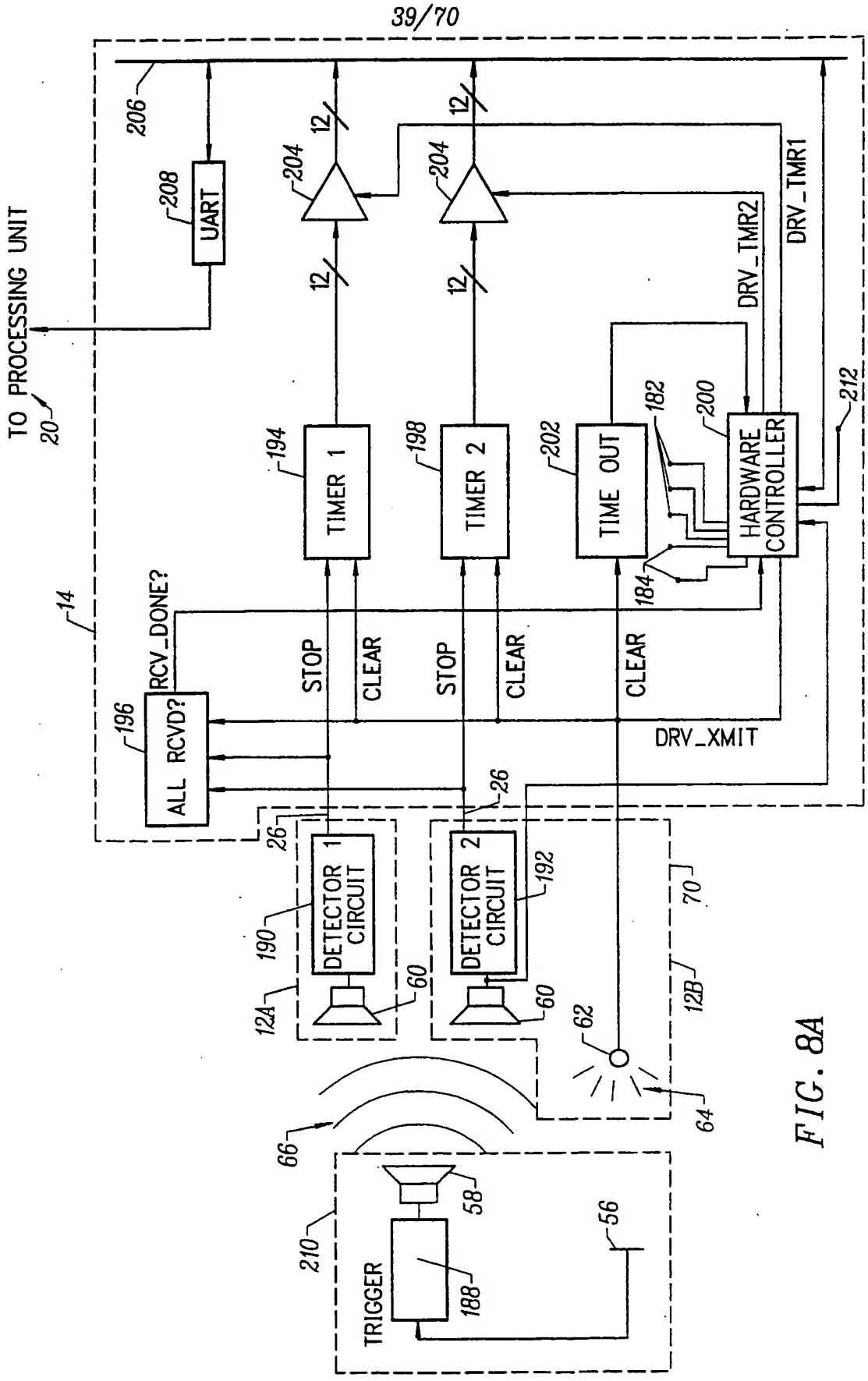

TO PROCESSING UNIT
20
206
208
UART
204
204
12
12
12
12
DRV_TMR2
DRV_TMR1
212
182
200
194
TIMER 1
198
TIMER 2
202
TIME OUT
HARDWARE CONTROLLER
184
14
RCV_DONE?
196
ALL RCVD?
STOP
CLEAR
STOP
CLEAR
CLEAR
DRV_XMIT
26
26
DETECTOR 1 CIRCUIT
190
DETECTOR 2 CIRCUIT
192
70
124
60
60
62
12B
64
66
58
56
210
TRIGGER
188

FIG. 8A

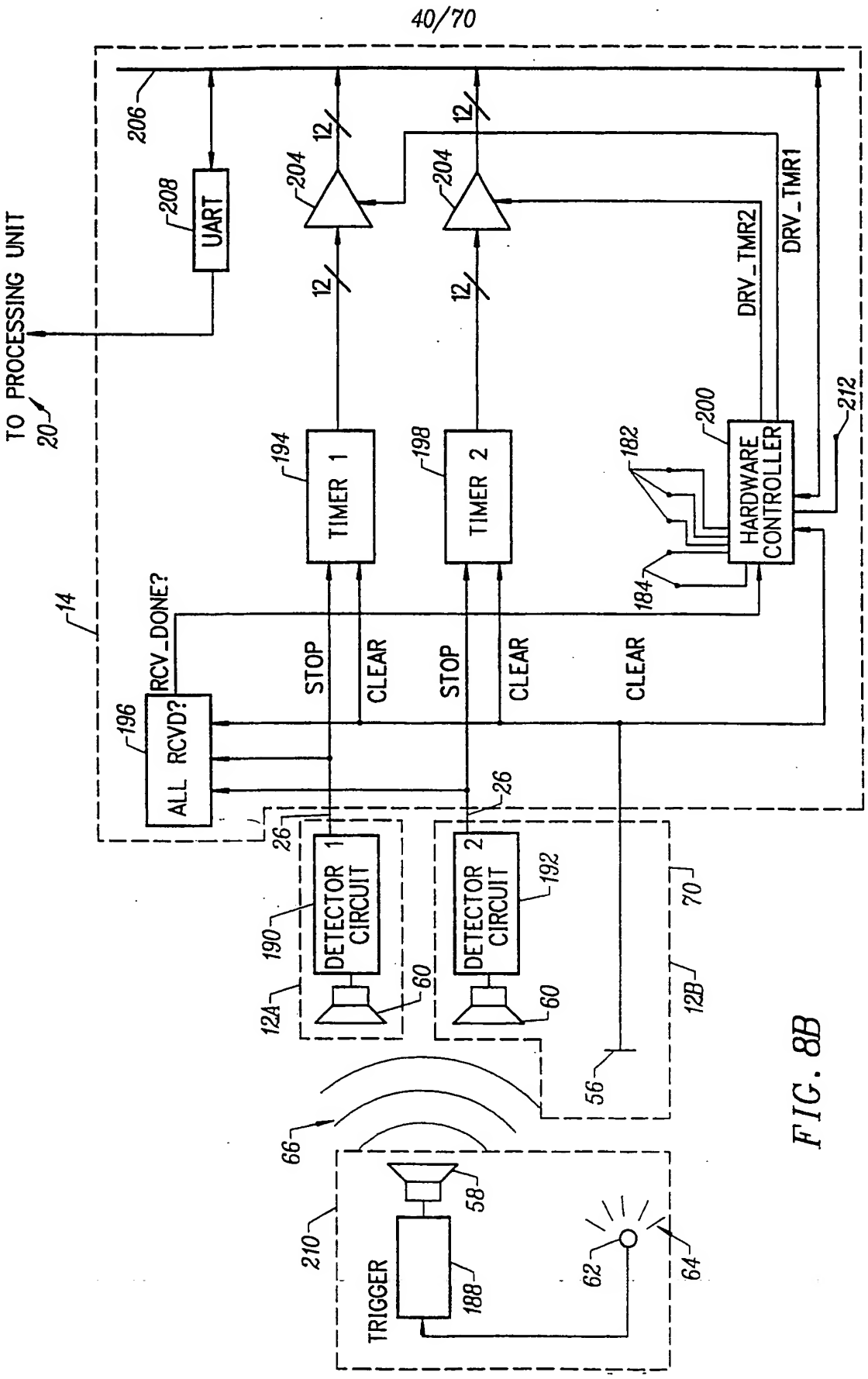

40/70
TO PROCESSING UNIT
20
206
208
UART
204
204
12
12
12
12
DRV_TMR2
DRV_TMR1
212
200
HARDWARE CONTROLLER
182
184
194
TIMER 1
198
TIMER 2
14
RCV_DONE?
196
ALL RCVD?
STOP
CLEAR
STOP
CLEAR
CLEAR
26
26
DETECTOR 1 CIRCUIT
190
DETECTOR 2 CIRCUIT
192
70
12A
12B
60
60
56
66
58
210
TRIGGER
188
62
64

FIG. 8B

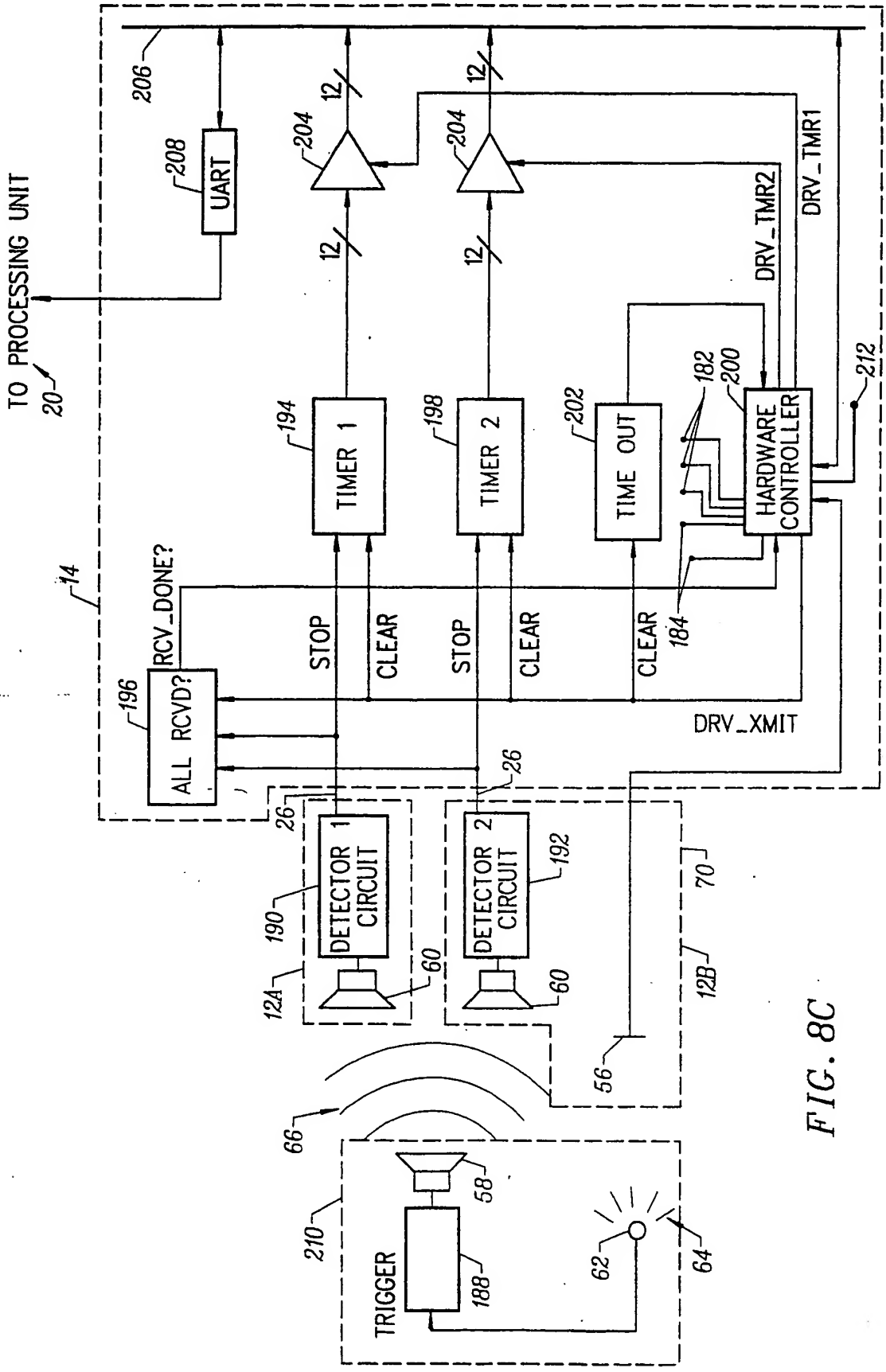

TO PROCESSING UNIT
20
206
208
UART
12
204
12
204
DRV_TMR1
DRV_TMR2
182
200
212
194
TIMER 1
198
TIMER 2
202
TIME OUT
HARDWARE CONTROLLER
14
RCV_DONE?
STOP
CLEAR
STOP
CLEAR
CLEAR
184
196
ALL RCVD?
DRV_XMIT
26
26
DETECTOR 1 CIRCUIT
190
DETECTOR 2 CIRCUIT
192
70
12A
60
60
12B
56
66
58
210
TRIGGER
188
62
64

FIG. 8C

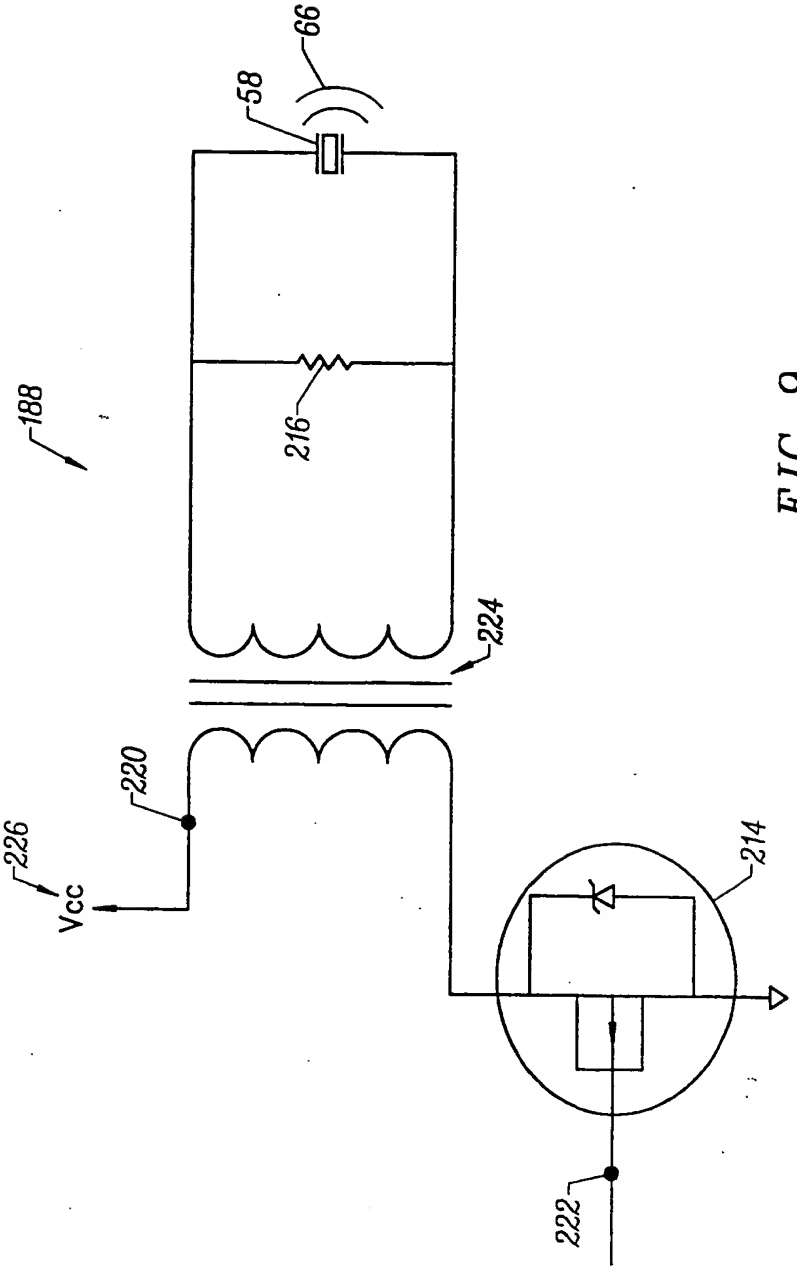


FIG. 9

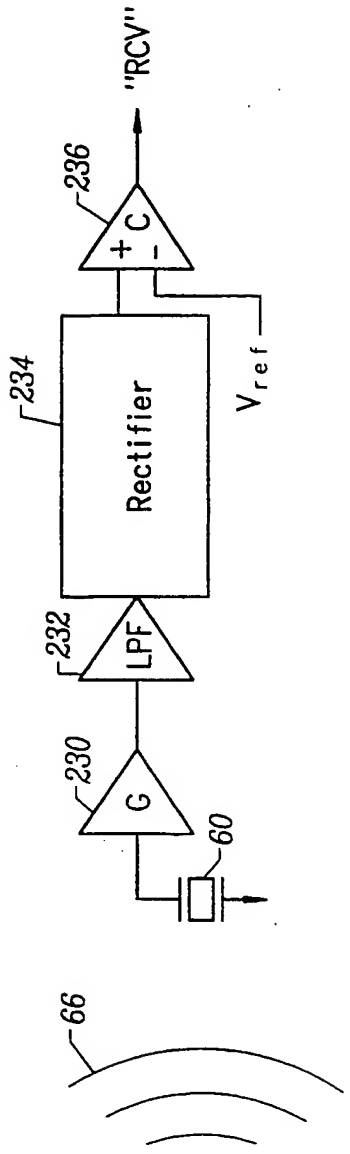


FIG. 10

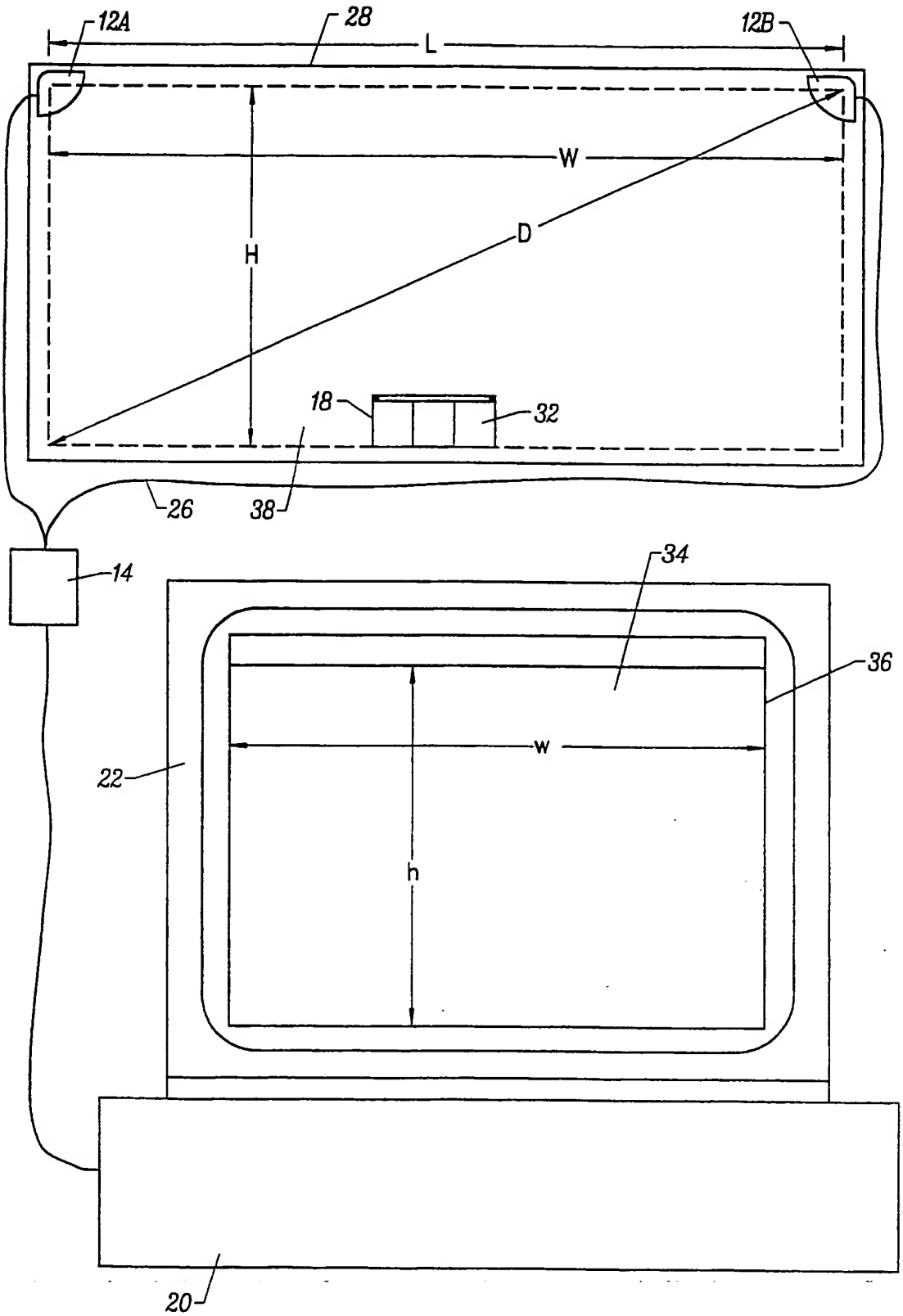


FIG. 11A

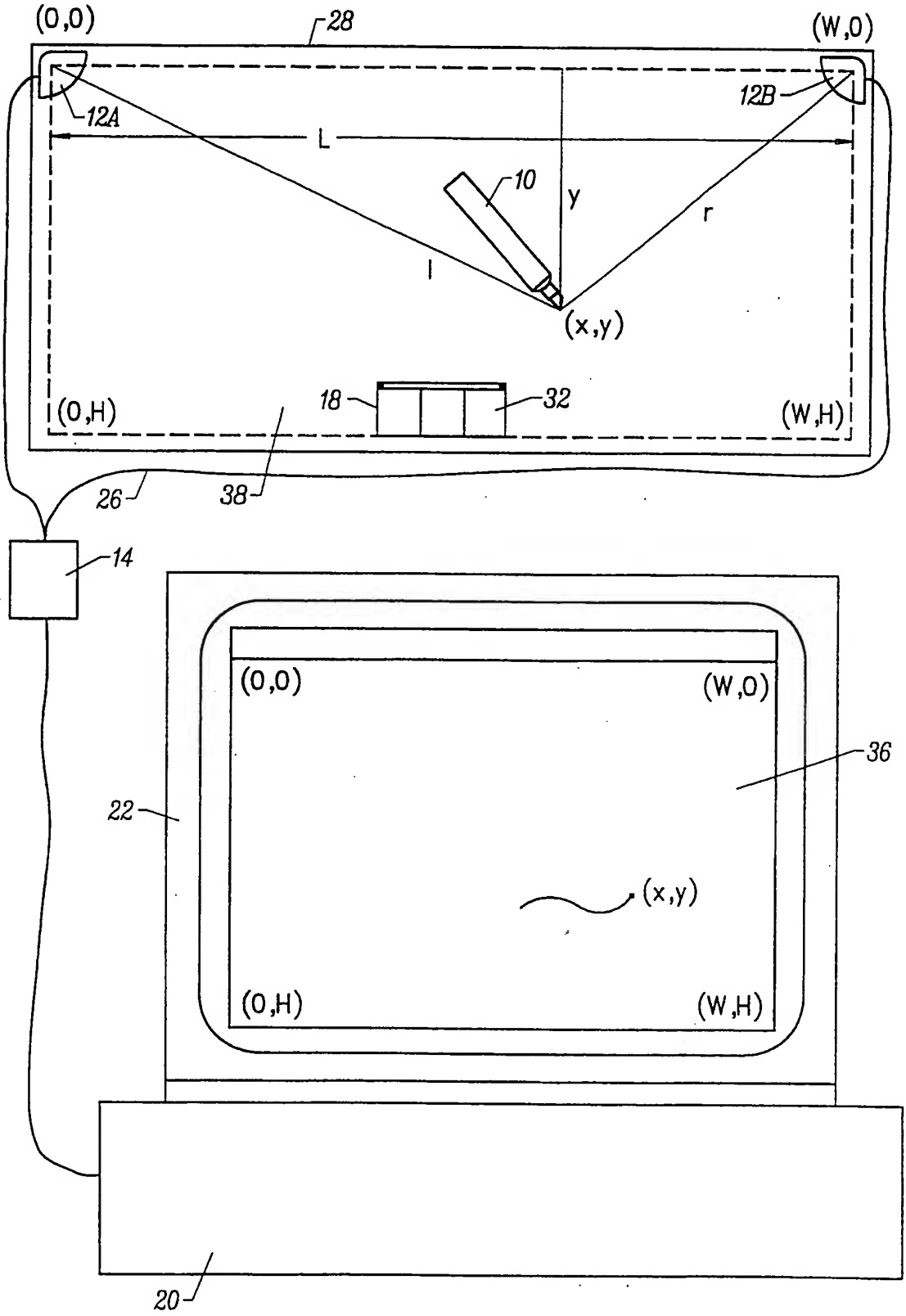

(0,0)
28
(W,0)
12A
12B
L
10
y
r
l
(x,y)
(0,H)
18
32
(W,H)
26
38
14
(0,0)
(W,0)
36
22
(x,y)
(0,H)
(W,H)
20

FIG. 11B

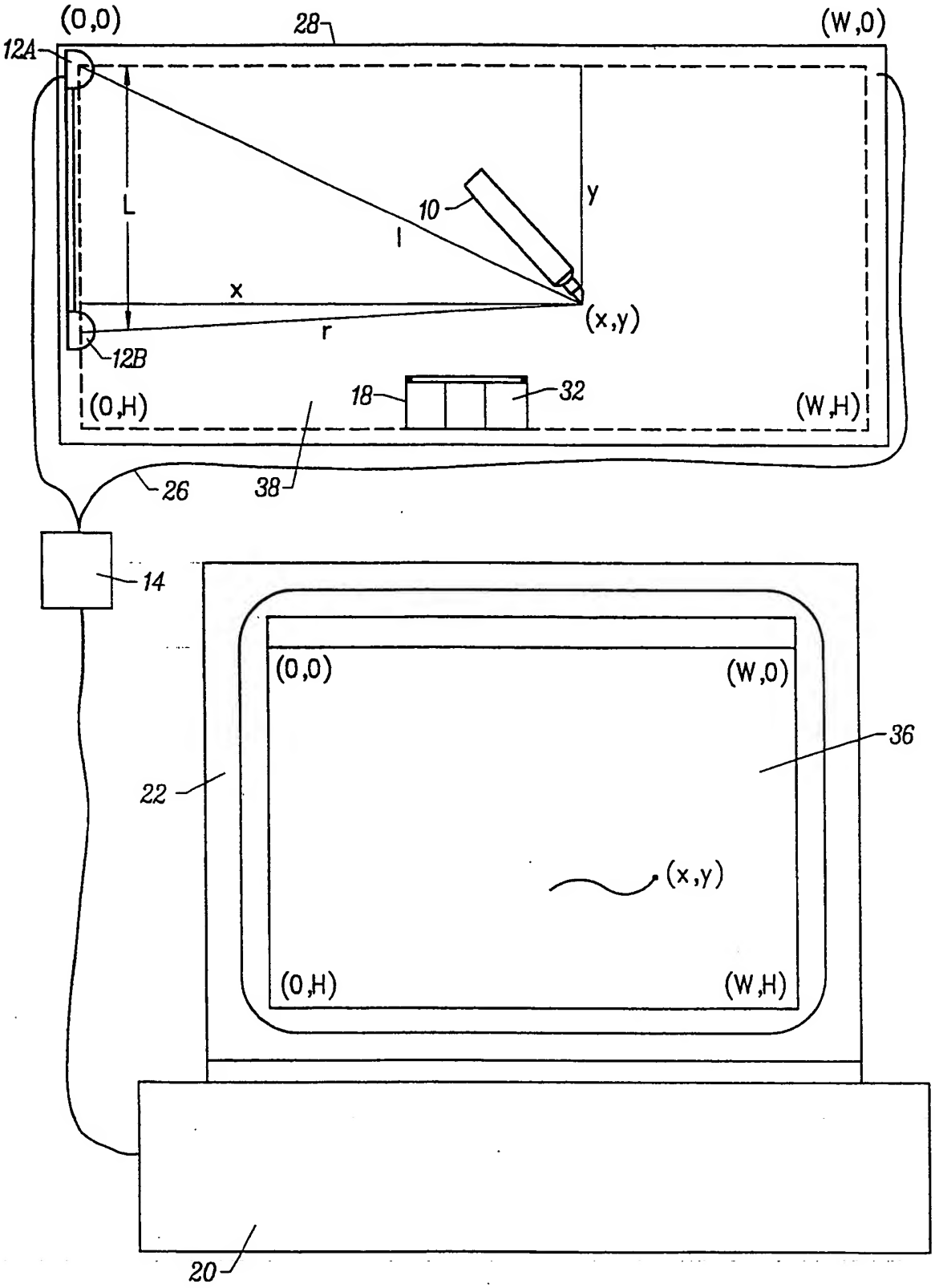

(0,0)
28
(W,0)
12A
L
y
10
l
x
(x,y)
r
12B
(0,H)
18
32
(W,H)
26
38
14
(0,0)
(W,0)
36
22
(x,y)
(0,H)
(W,H)
20

FIG. 11C

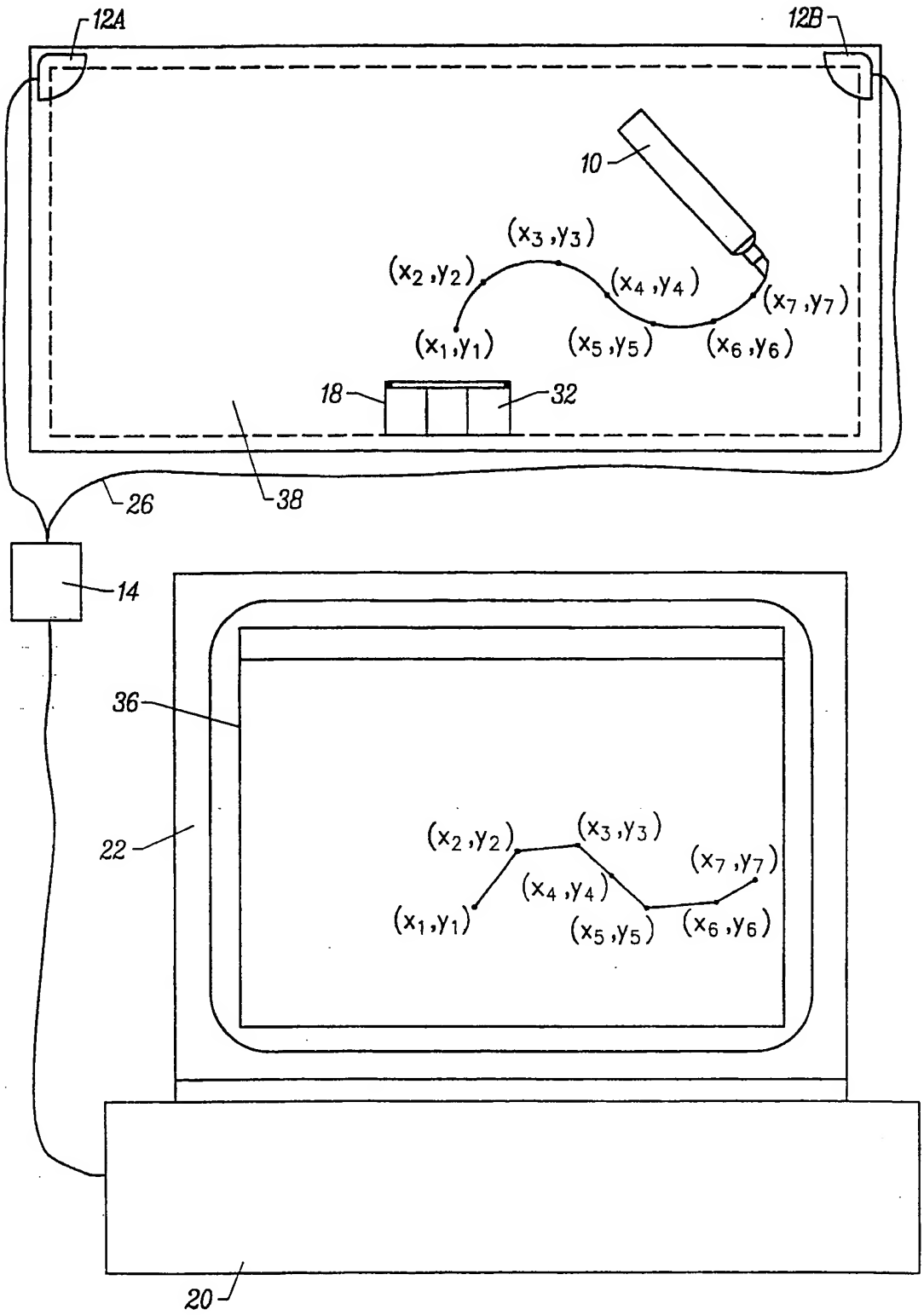

12A
12B
10
(x_3, y_3)
(x_2, y_2)
(x_4, y_4)
(x_7, y_7)
(x_1, y_1)
(x_5, y_5)
(x_6, y_6)
18
32
26
38
14
36
22
(x_2, y_2)
(x_3, y_3)
(x_7, y_7)
(x_4, y_4)
(x_1, y_1)
(x_5, y_5)
(x_6, y_6)
20

FIG. 11D

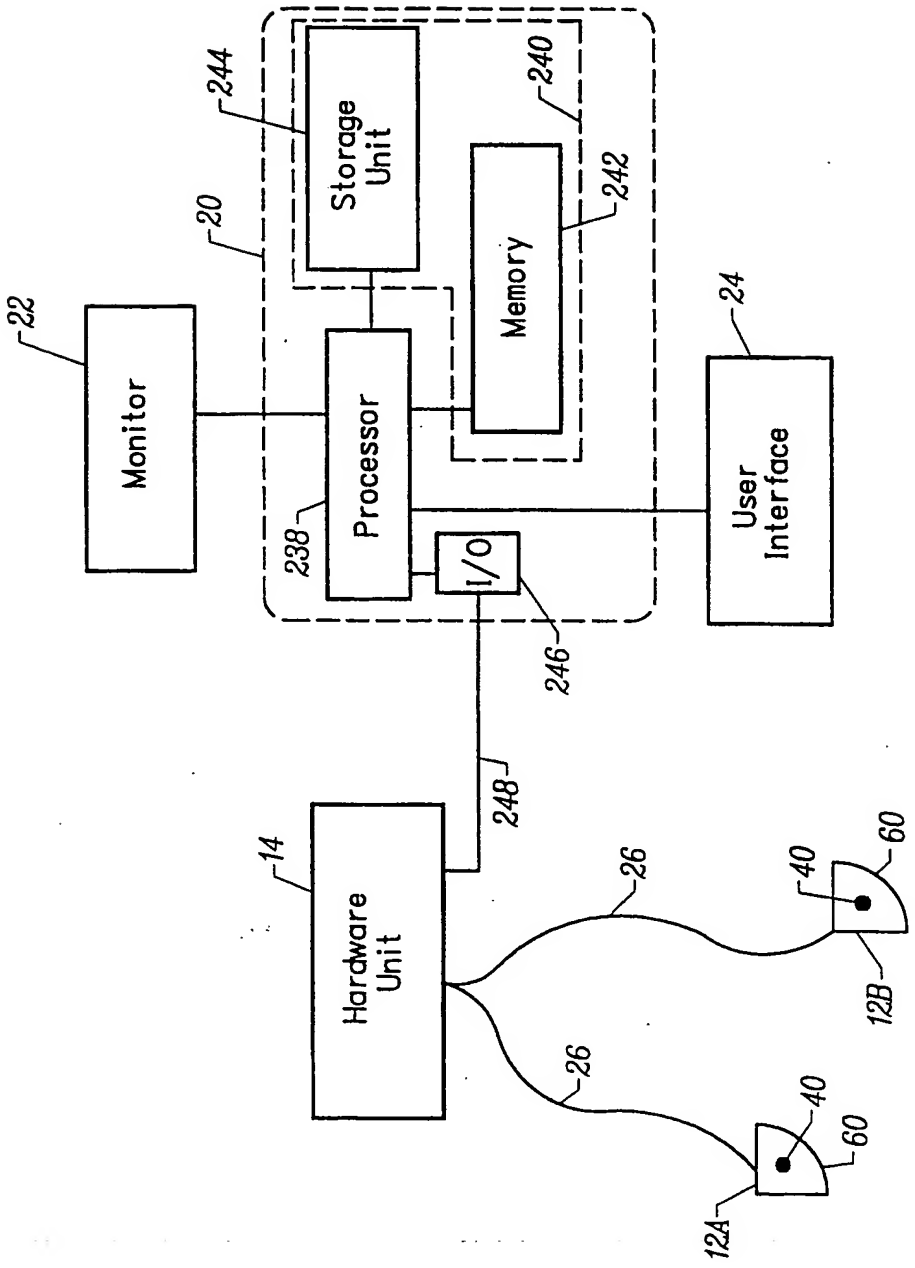

Storage Unit
244
240
Memory
242
20
22
Monitor
Processor
238
I/O
246
24
User Interface
248
14
Hardware Unit
26
40
60
12B
26
40
60
12A

FIG. 12

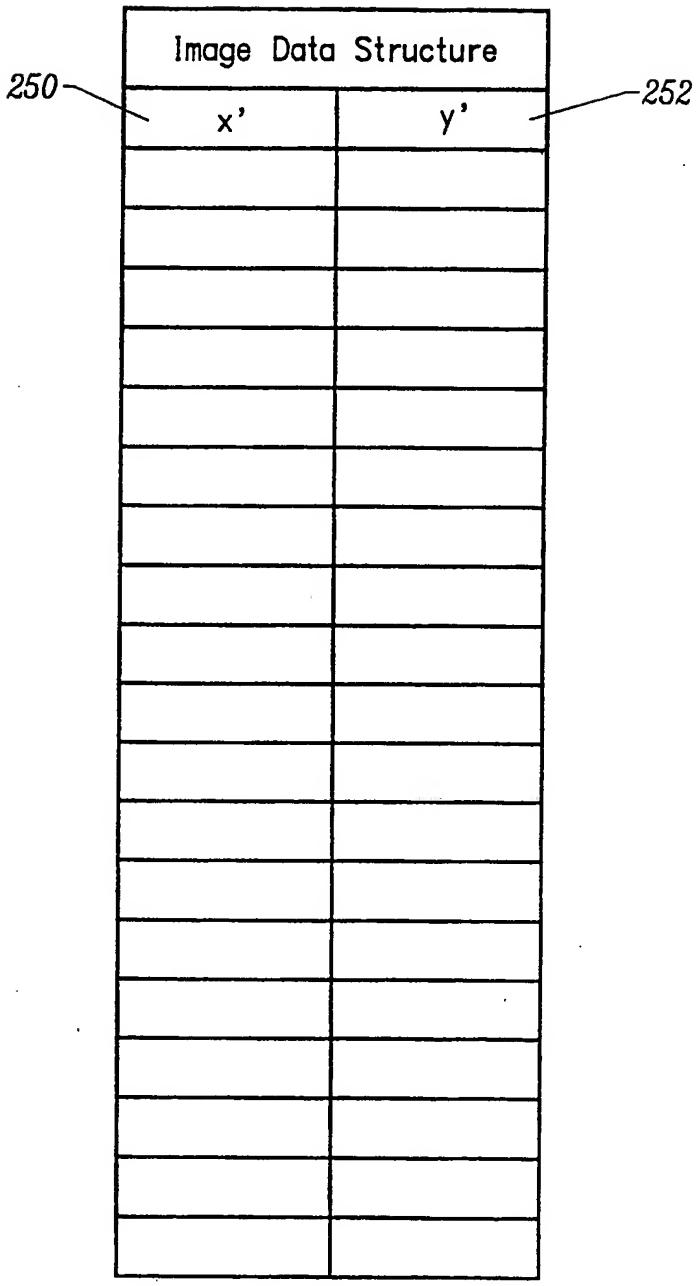


FIG. 13

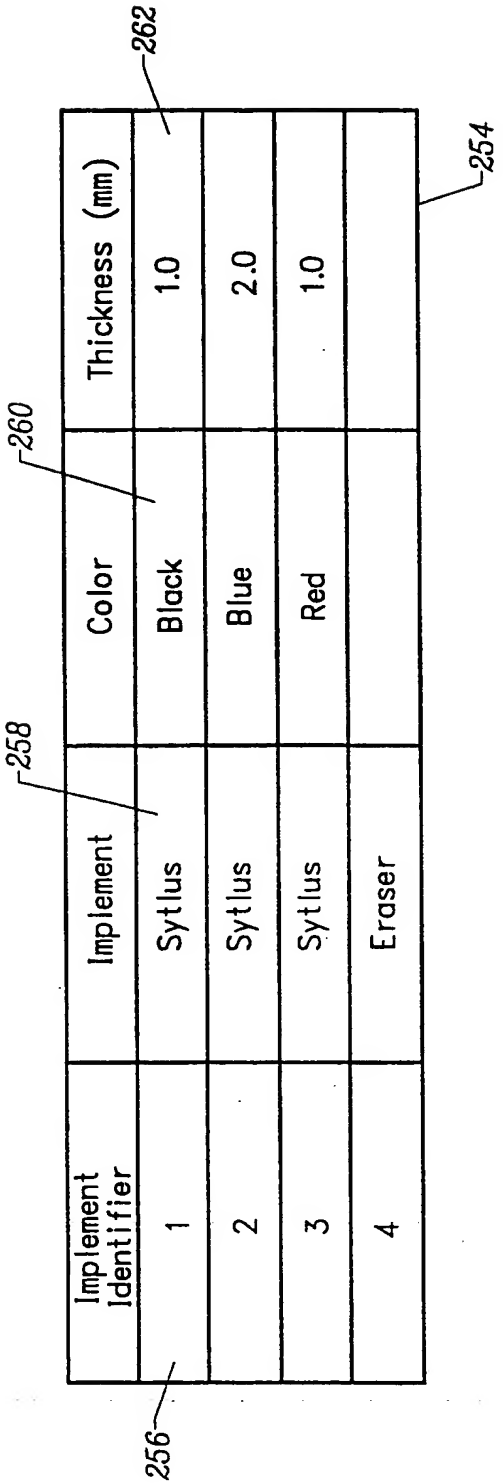

262
254
260
258
256
Implement Identifier
Implement
Color
Thickness (mm)
1
Sytlus
Black
1.0
2
Sytlus
Blue
2.0
3
Sytlus
Red
1.0
4
Eraser

FIG. 14

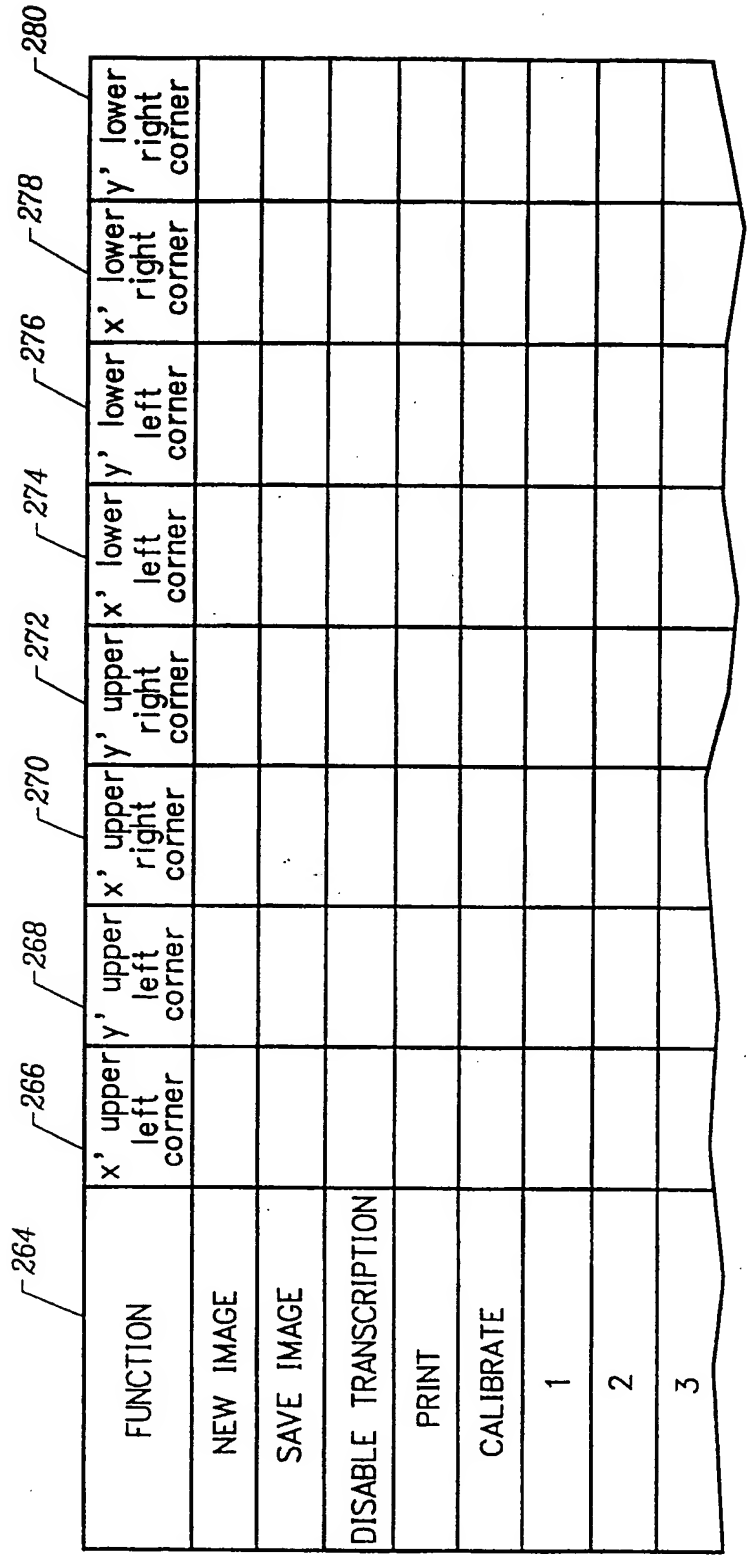

264
266
268
270
272
274
276
278
280
FUNCTION
x' upper left corner
y' upper left corner
x' upper right corner
y' upper right corner
x' lower left corner
y' lower left corner
x' lower right corner
y' lower right corner
NEW IMAGE
SAVE IMAGE
DISABLE TRANSCRIPTION
PRINT
CALIBRATE
1
2
3

FIG. 15A

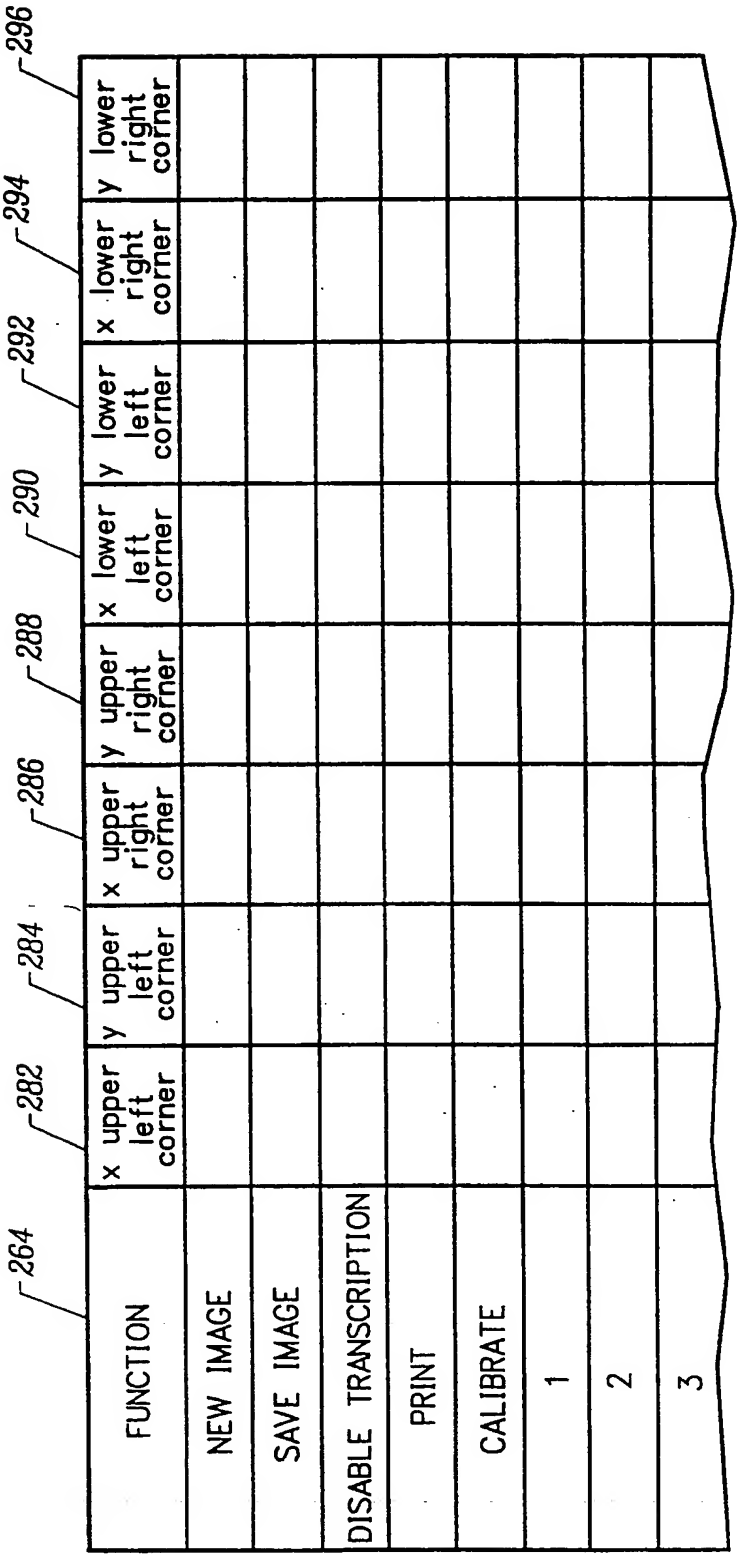

264
282
284
286
288
290
292
294
296
FUNCTION
x upper left corner
y upper left corner
x upper right corner
y upper right corner
x lower left corner
y lower left corner
x lower right corner
y lower right corner
NEW IMAGE
SAVE IMAGE
DISABLE TRANSCRIPTION
PRINT
CALIBRATE
1
2
3

FIG. 15B

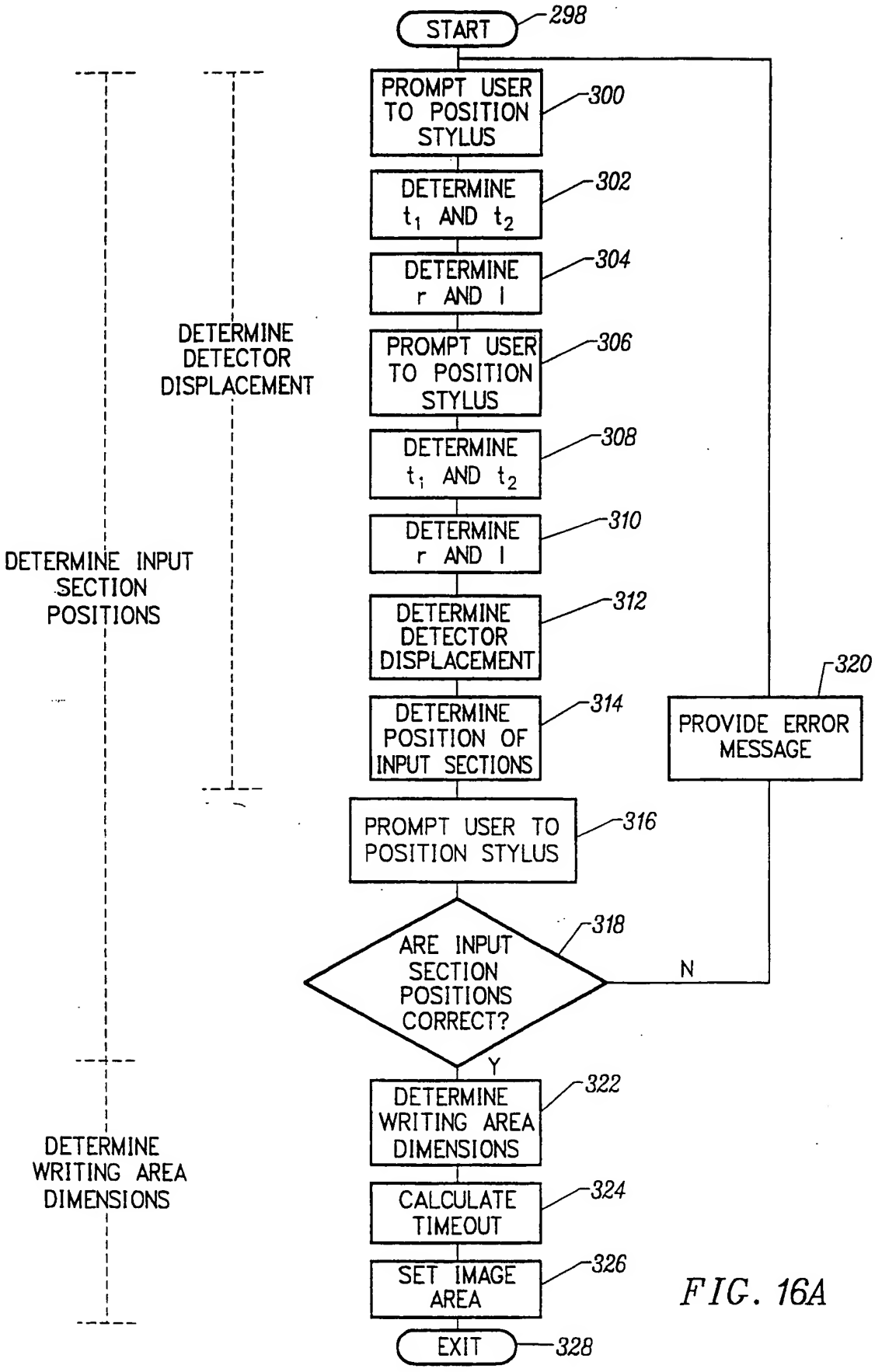

START
298
PROMPT USER TO POSITION STYLUS
300
DETERMINE t_1 AND t_2
302
DETERMINE r AND I
304
PROMPT USER TO POSITION STYLUS
306
DETERMINE t_1 AND t_2
308
DETERMINE r AND I
310
DETERMINE DETECTOR DISPLACEMENT
312
DETERMINE POSITION OF INPUT SECTIONS
314
PROMPT USER TO POSITION STYLUS
316
ARE INPUT SECTION POSITIONS CORRECT?
318
N
Y
PROVIDE ERROR MESSAGE
320
DETERMINE WRITING AREA DIMENSIONS
322
CALCULATE TIMEOUT
324
SET IMAGE AREA
326
EXIT
328
DETERMINE DETECTOR DISPLACEMENT
DETERMINE INPUT SECTION POSITIONS
DETERMINE WRITING AREA DIMENSIONS

FIG. 16A

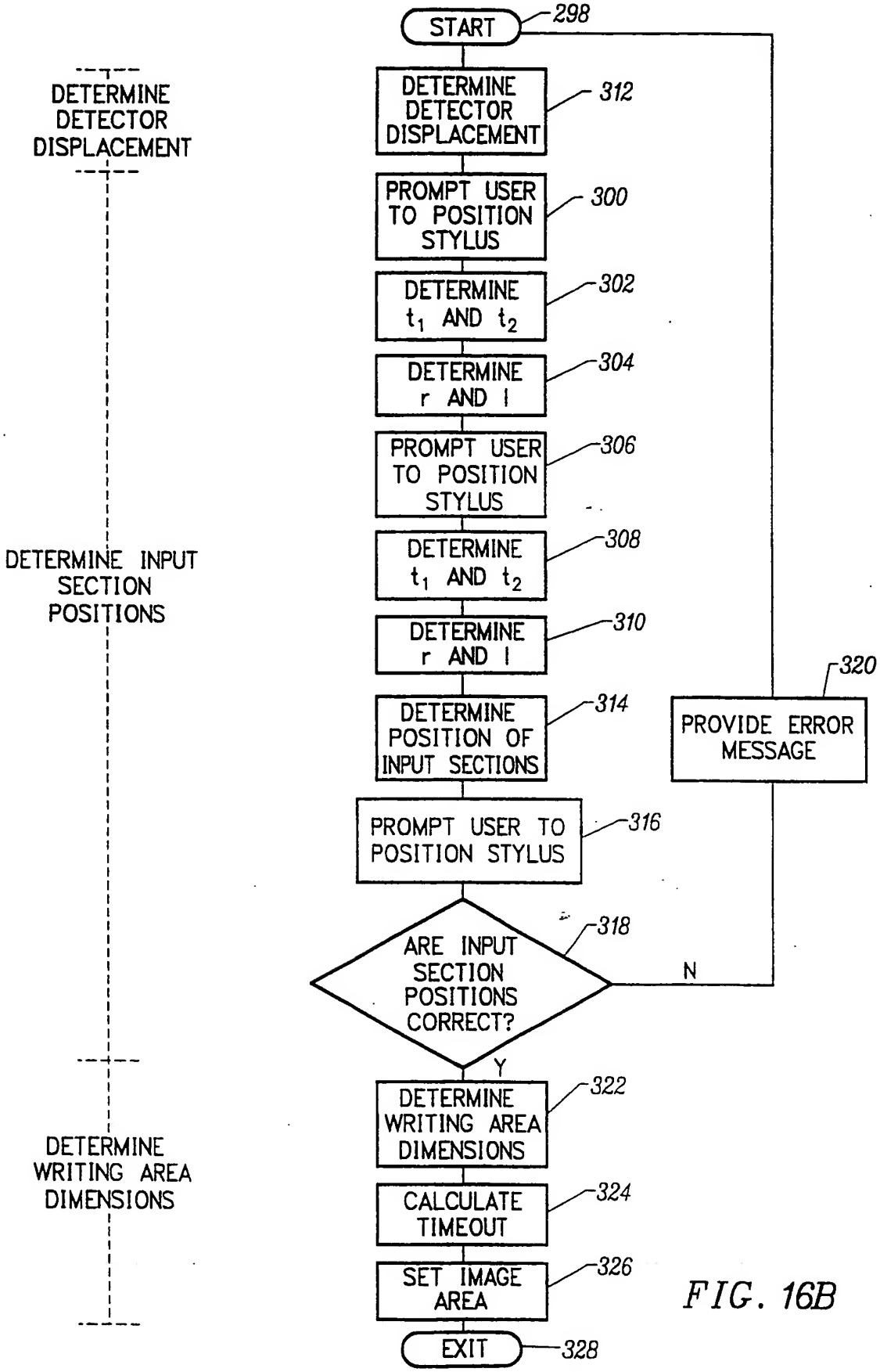

START
298
DETERMINE DETECTOR DISPLACEMENT
312
PROMPT USER TO POSITION STYLUS
300
DETERMINE t_1 AND t_2
302
DETERMINE r AND I
304
PROMPT USER TO POSITION STYLUS
306
DETERMINE t_1 AND t_2
308
DETERMINE r AND I
310
DETERMINE POSITION OF INPUT SECTIONS
314
PROMPT USER TO POSITION STYLUS
316
ARE INPUT SECTION POSITIONS CORRECT?
318
N
Y
PROVIDE ERROR MESSAGE
320
DETERMINE WRITING AREA DIMENSIONS
322
CALCULATE TIMEOUT
324
SET IMAGE AREA
326
EXIT
328
DETERMINE DETECTOR DISPLACEMENT
DETERMINE INPUT SECTION POSITIONS
DETERMINE WRITING AREA DIMENSIONS

FIG. 16B

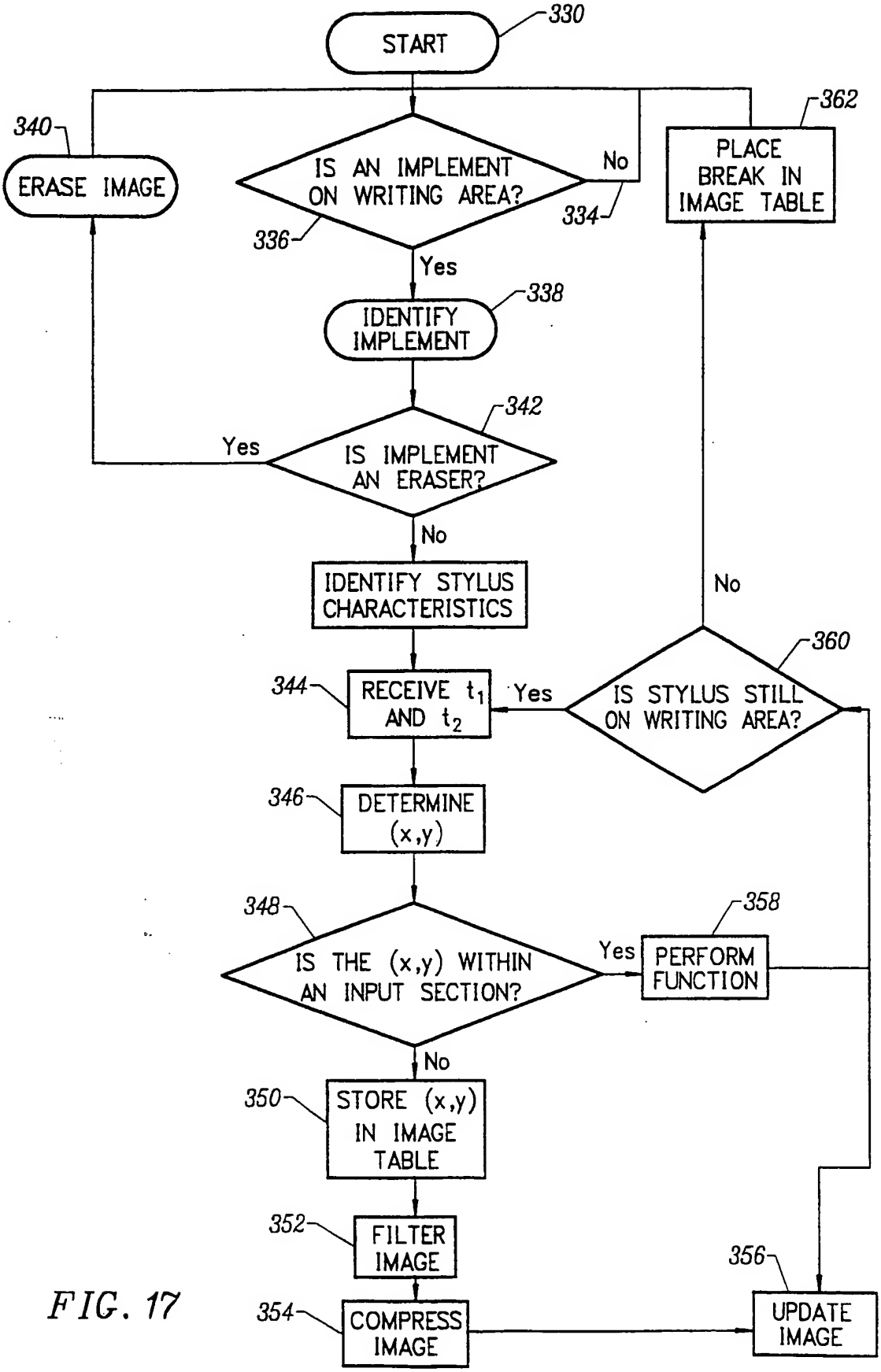

START
330
IS AN IMPLEMENT ON WRITING AREA?
No
Yes
336
334
340
ERASE IMAGE
362
PLACE BREAK IN IMAGE TABLE
IDENTIFY IMPLEMENT
338
342
IS IMPLEMENT AN ERASER?
Yes
No
IDENTIFY STYLUS CHARACTERISTICS
360
IS STYLUS STILL ON WRITING AREA?
No
Yes
344
RECEIVE t_1 AND t_2
346
DETERMINE (x,y)
348
IS THE (x,y) WITHIN AN INPUT SECTION?
Yes
358
PERFORM FUNCTION
No
350
STORE (x,y) IN IMAGE TABLE
352
FILTER IMAGE
354
COMPRESS IMAGE
356
UPDATE IMAGE

FIG. 17

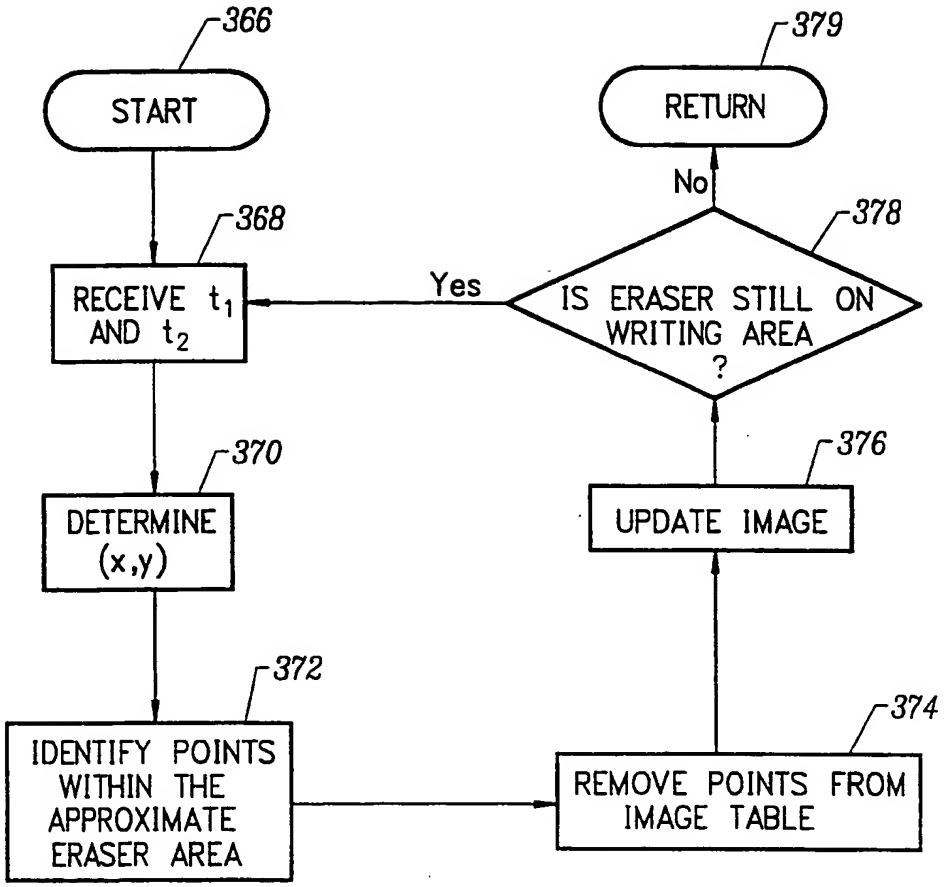

366
START
368
RECEIVE t_1 AND t_2
370
DETERMINE (x,y)
372
IDENTIFY POINTS WITHIN THE APPROXIMATE ERASER AREA
374
REMOVE POINTS FROM IMAGE TABLE
376
UPDATE IMAGE
378
IS ERASER STILL ON WRITING AREA ?
Yes
No
379
RETURN

FIG. 18

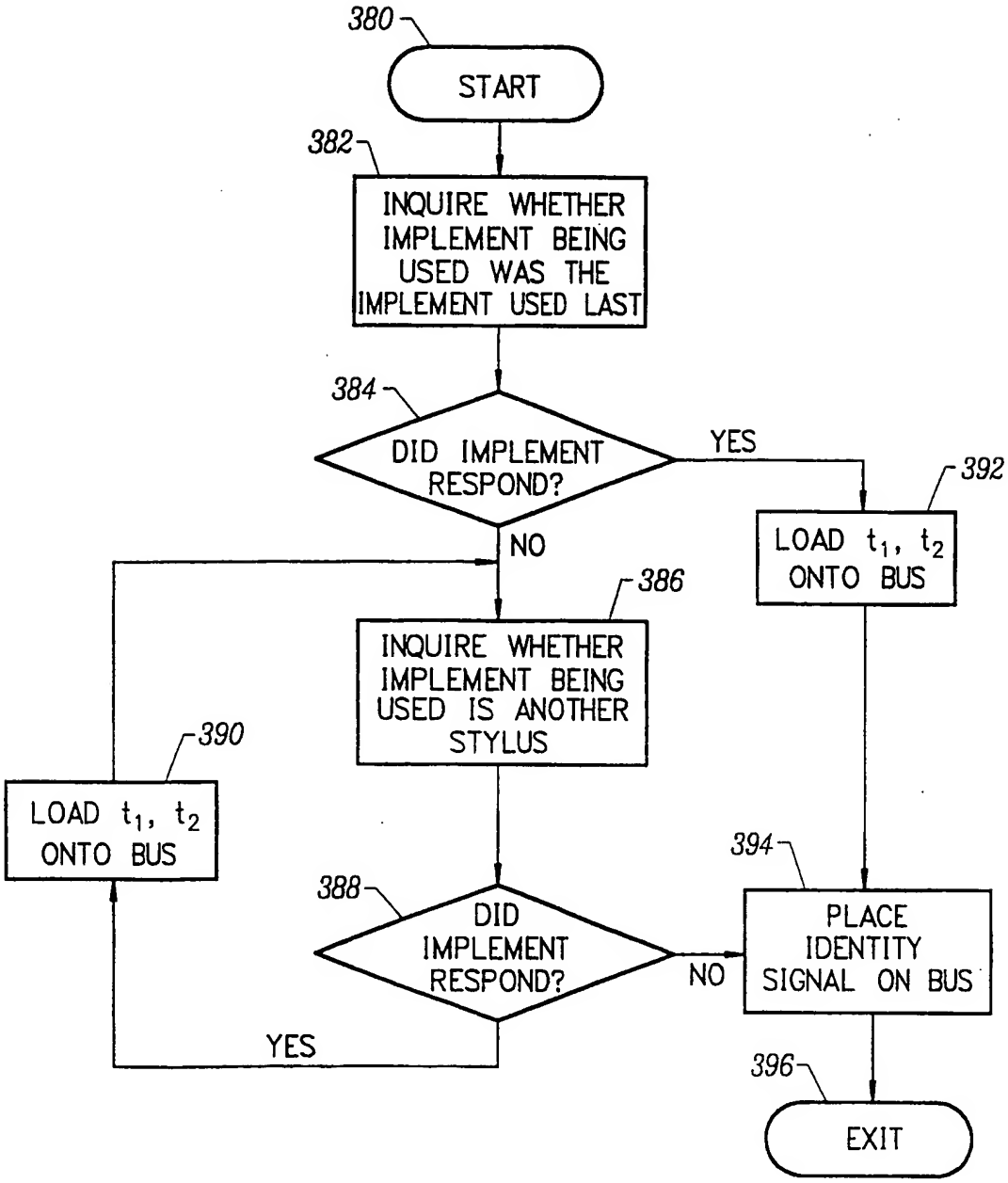

380
START
382
INQUIRE WHETHER IMPLEMENT BEING USED WAS THE IMPLEMENT USED LAST
384
DID IMPLEMENT RESPOND?
YES
392
LOAD t_1, t_2 ONTO BUS
NO
386
INQUIRE WHETHER IMPLEMENT BEING USED IS ANOTHER STYLUS
390
LOAD t_1, t_2 ONTO BUS
394
388
DID IMPLEMENT RESPOND?
NO
PLACE IDENTITY SIGNAL ON BUS
YES
396
EXIT

FIG. 19A

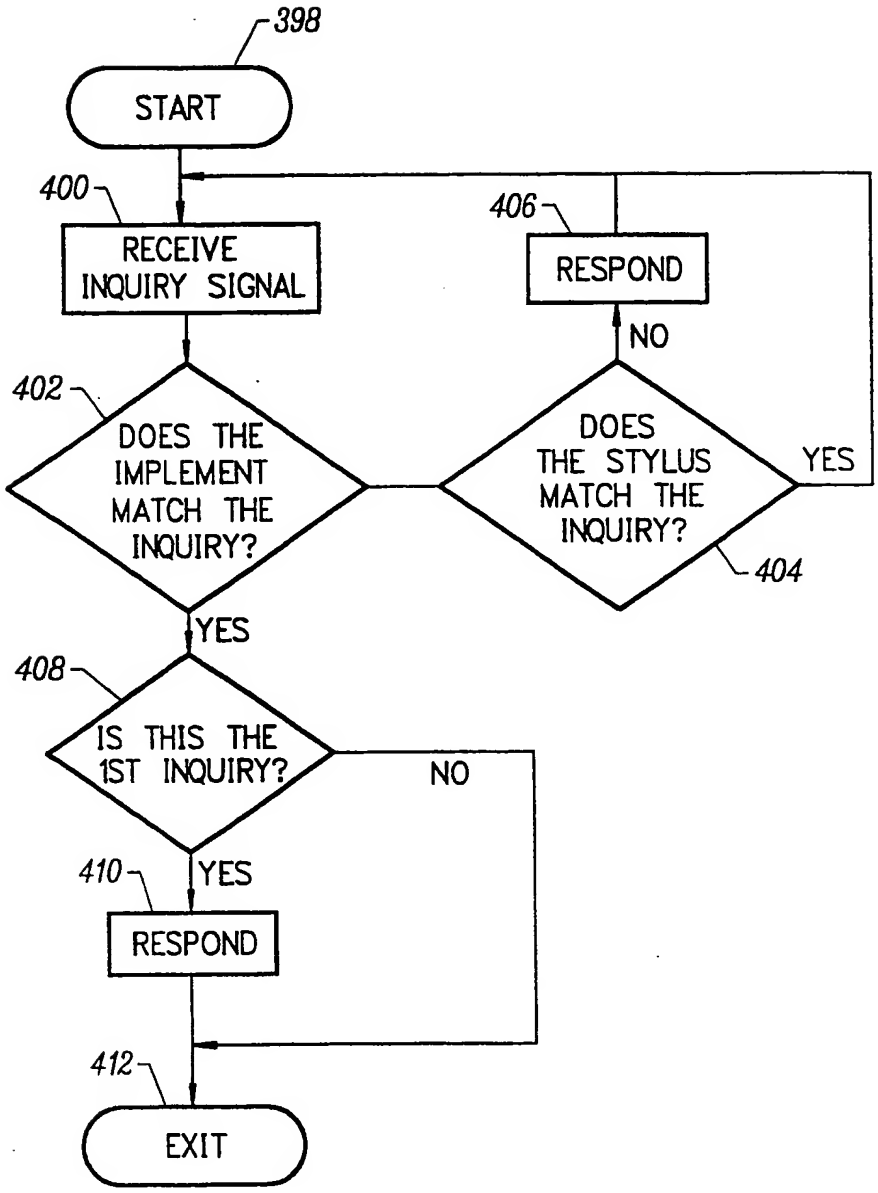

398
START
400
RECEIVE INQUIRY SIGNAL
402
DOES THE IMPLEMENT MATCH THE INQUIRY?
406
RESPOND
NO
DOES THE STYLUS MATCH THE INQUIRY?
YES
404
YES
408
IS THIS THE 1ST INQUIRY?
NO
410
YES
RESPOND
412
EXIT

FIG. 19B

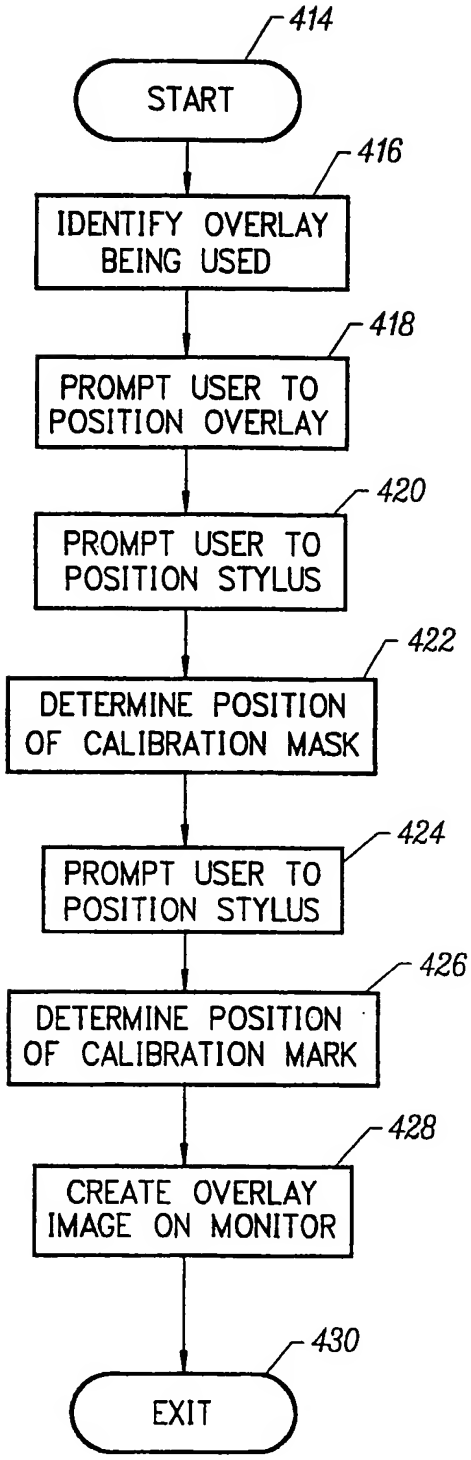

414
START
416
IDENTIFY OVERLAY BEING USED
418
PROMPT USER TO POSITION OVERLAY
420
PROMPT USER TO POSITION STYLUS
422
DETERMINE POSITION OF CALIBRATION MASK
424
PROMPT USER TO POSITION STYLUS
426
DETERMINE POSITION OF CALIBRATION MARK
428
CREATE OVERLAY IMAGE ON MONITOR
430
EXIT

FIG. 20

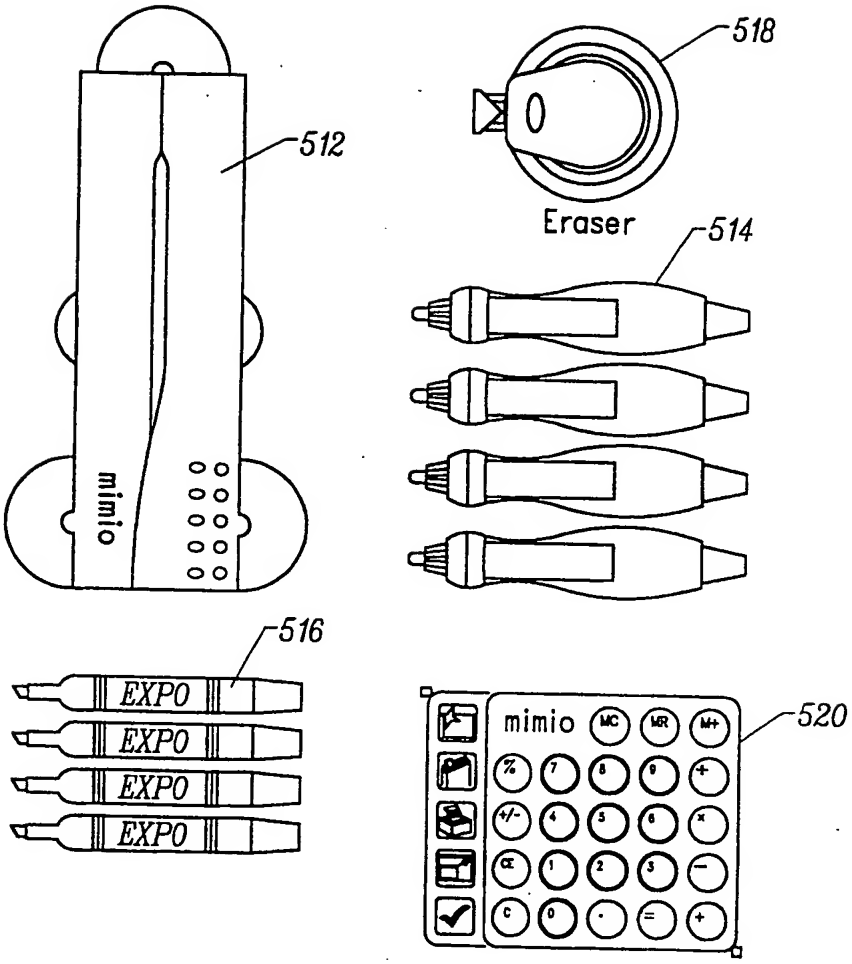


FIG. 21

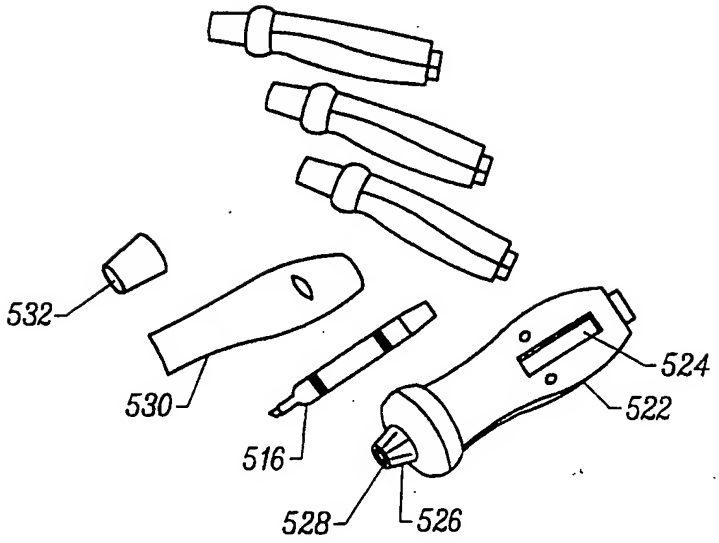
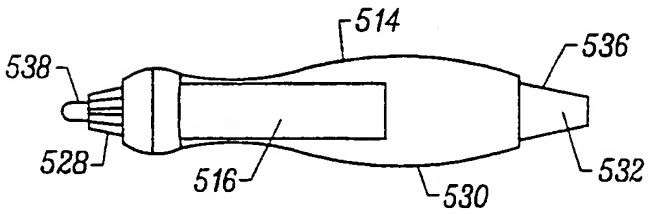
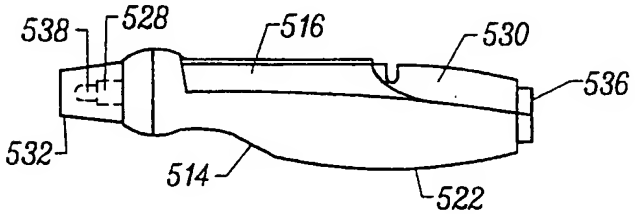


FIG. 22



Uncapped Stylus (ready for writing)

FIG. 23A



Capped Stylus (ready for storage)

FIG. 23B

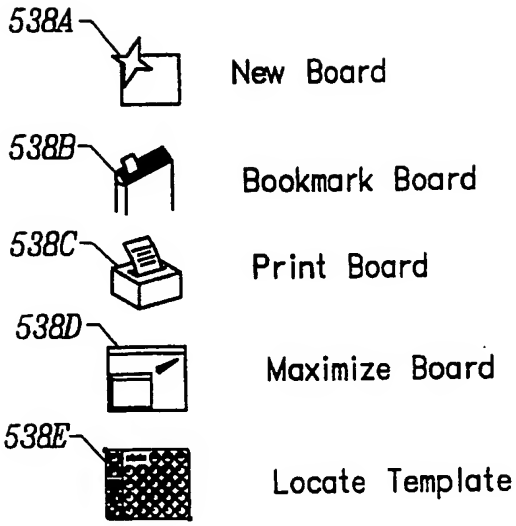


FIG. 24C

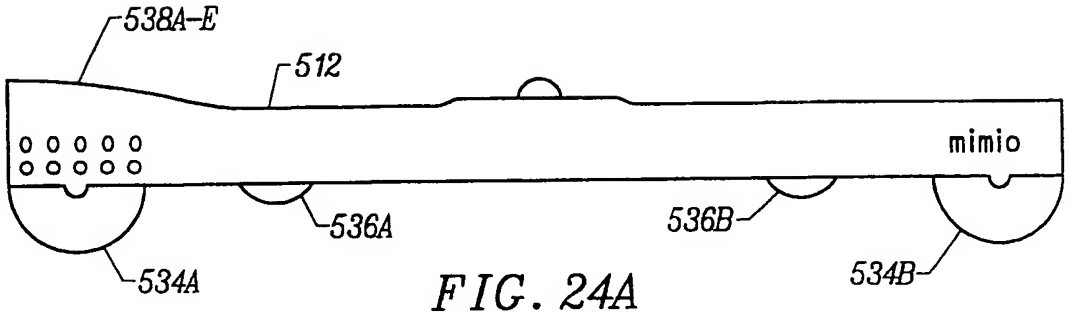


FIG. 24A

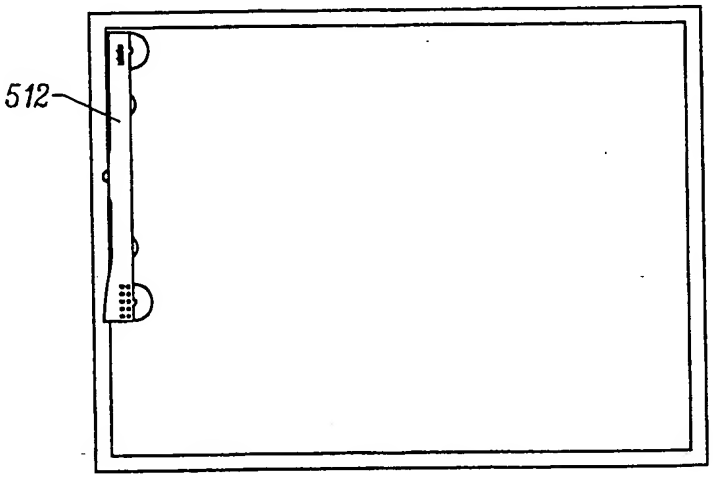


FIG. 24B

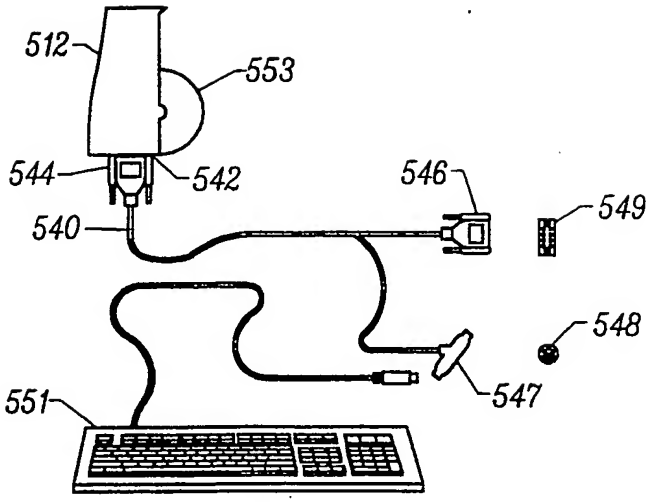


FIG. 25

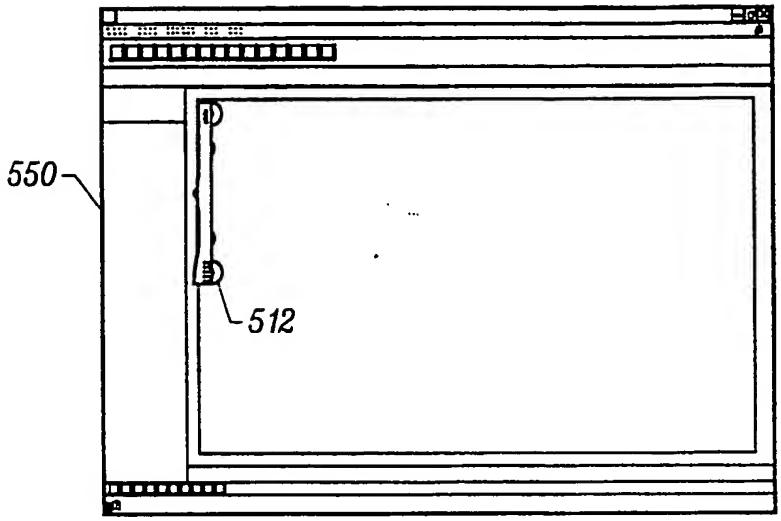


FIG. 26A

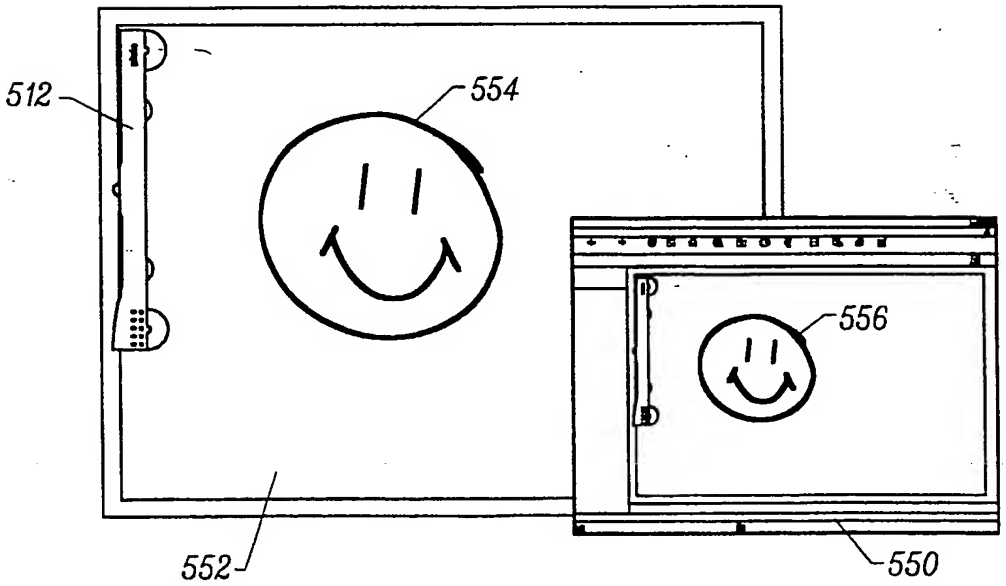


FIG. 26B

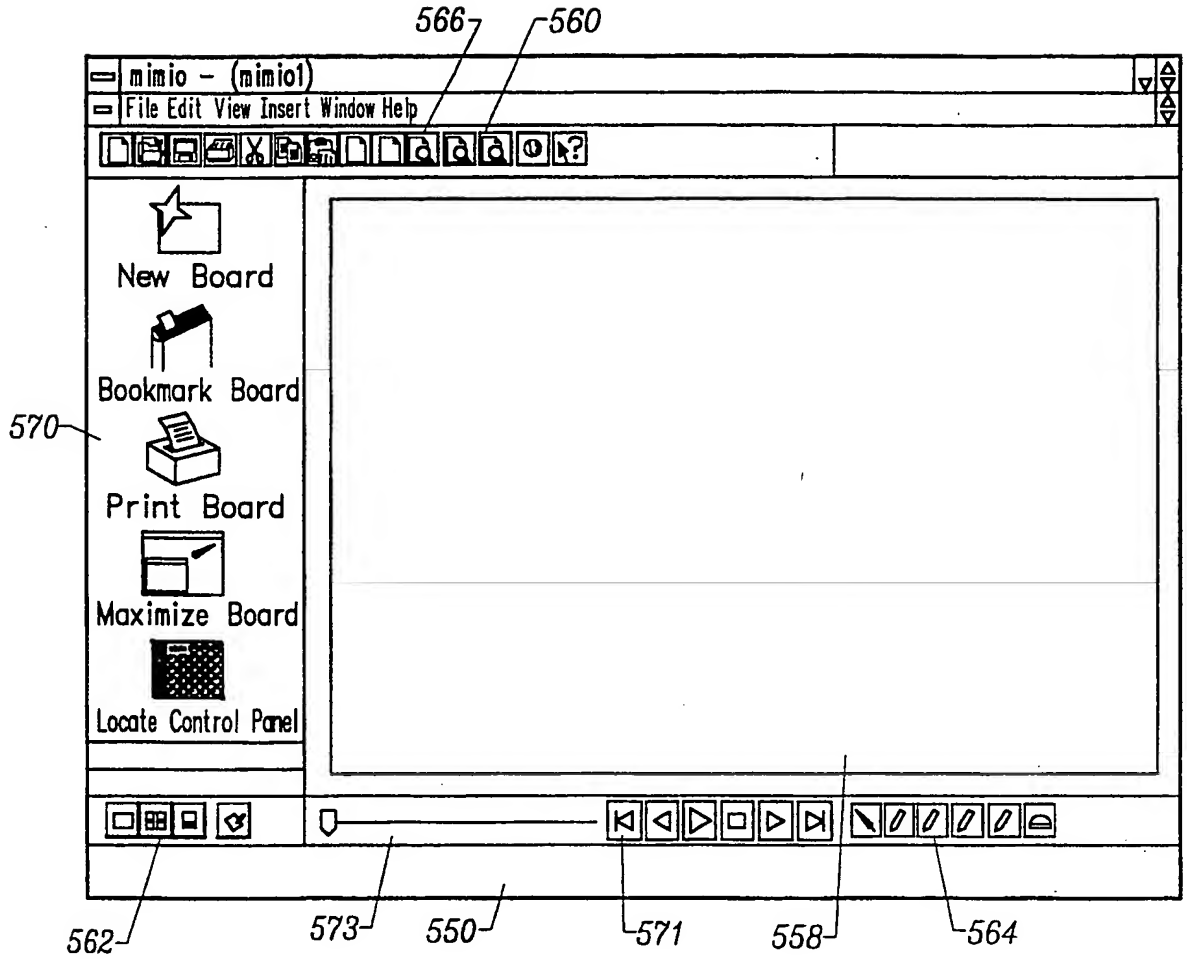
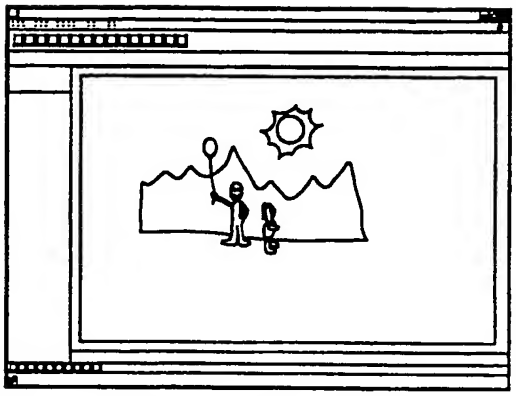
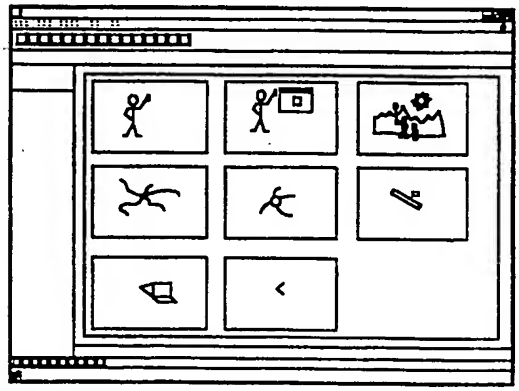

566
560
mimio - (mimio1)
File Edit View Insert Window Help
New Board
Bookmark Board
570
Print Board
Maximize Board
Locate Control Panel
562
573
550
571
558
564

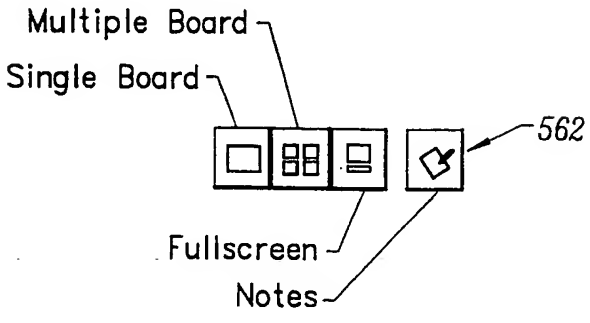
FIG. 27A



Single board display



Mulitple board display



Display toolbar

FIG. 27B

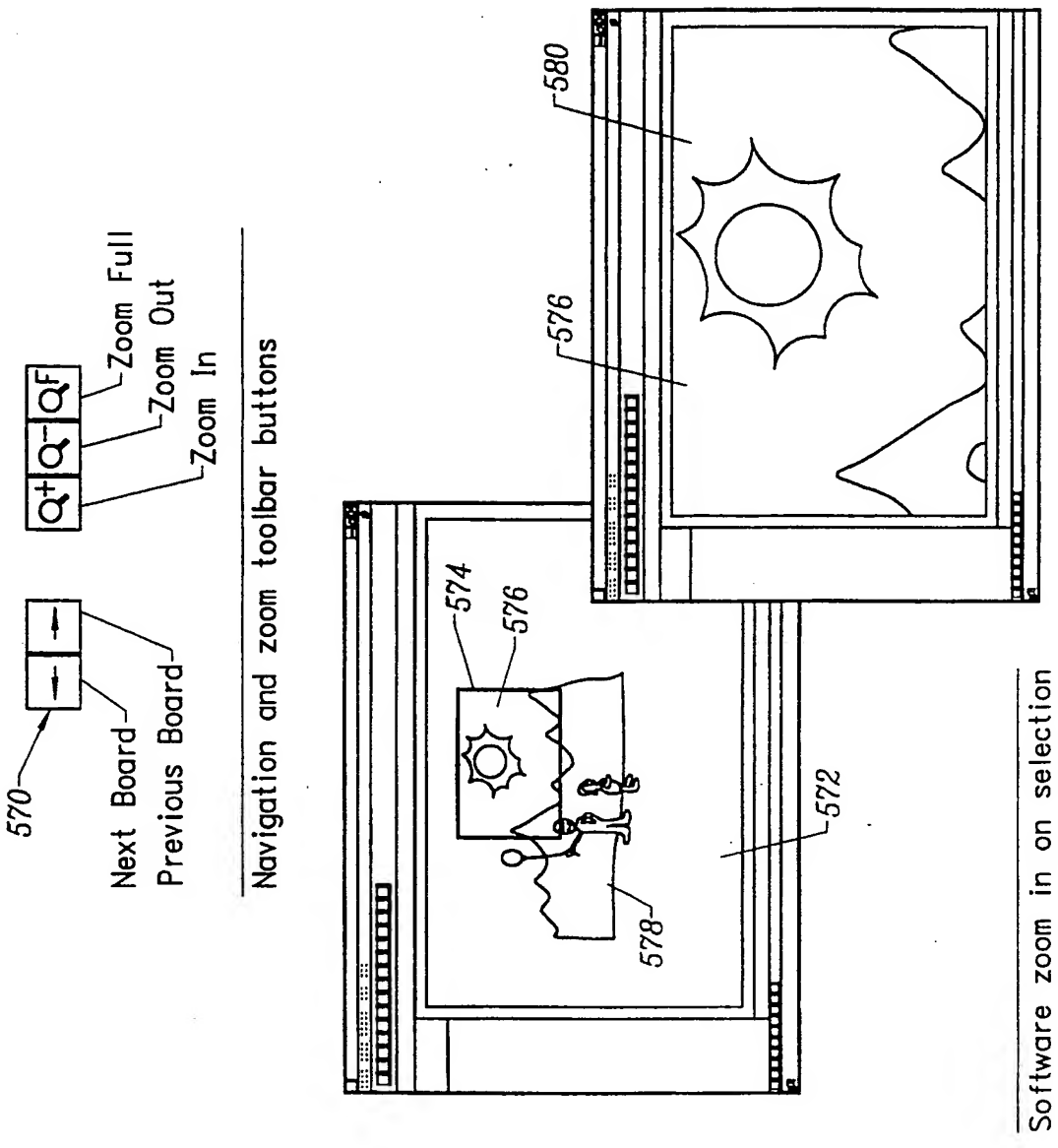

570
Next Board
Previous Board
Navigation and zoom toolbar buttons
Zoom Full
Zoom Out
Zoom In
580
576
574
576
572
578
Software zoom in on selection

FIG. 27C

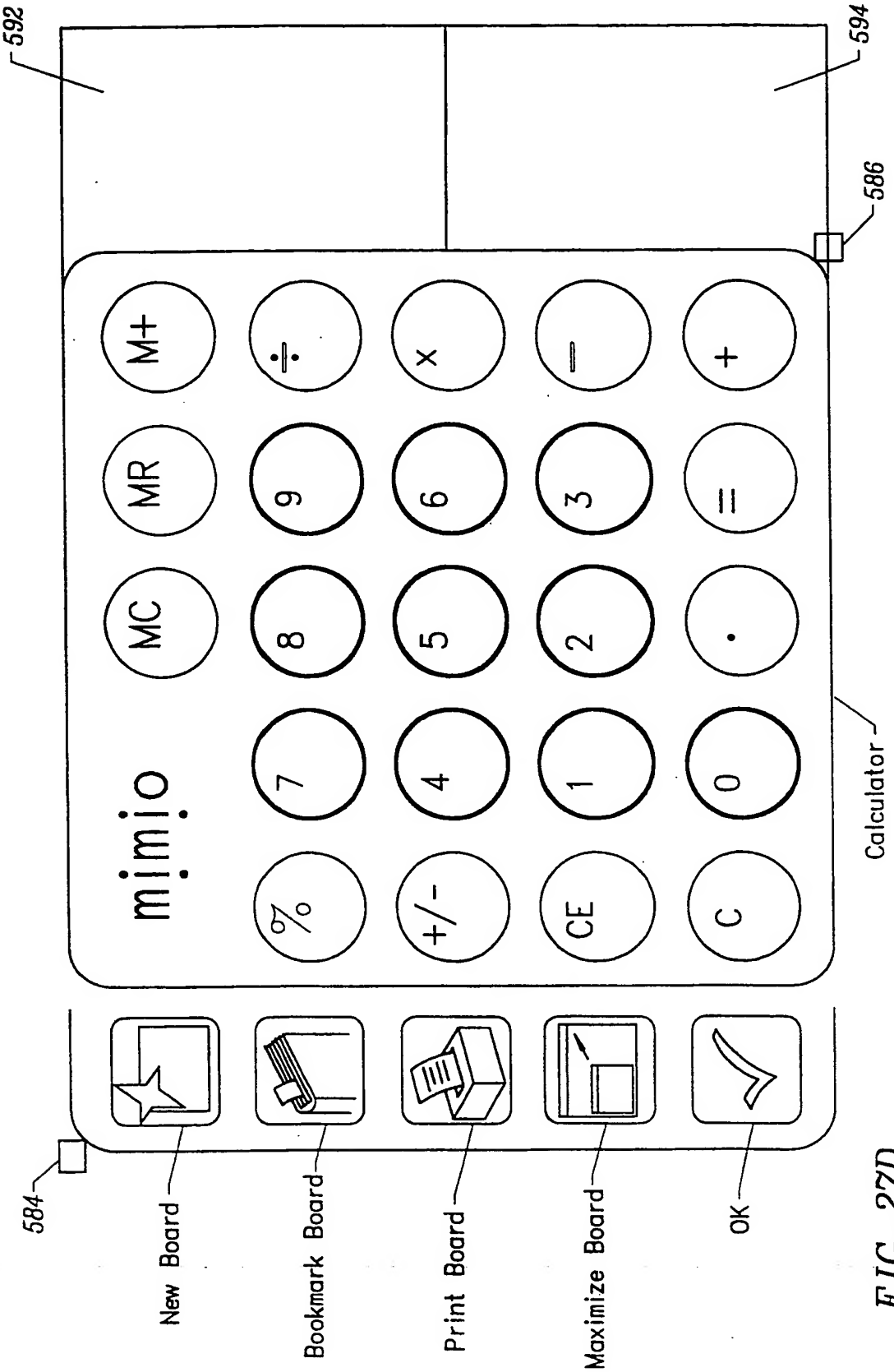
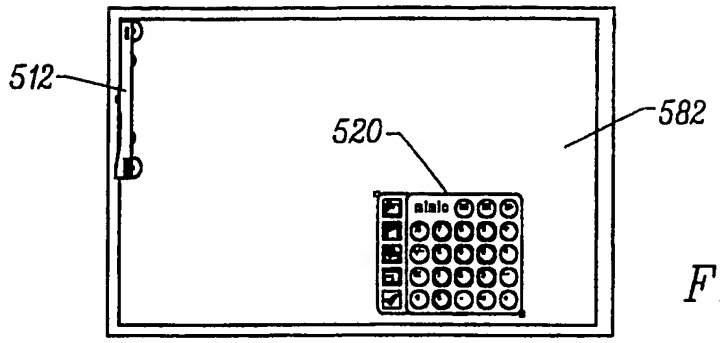

592
594
586
mimio
MC
MR
M+
7
8
9
÷
4
5
6
x
1
2
3
−
0
.
=
+
%
+/-
CE
C
Calculator
584
New Board
Bookmark Board
Print Board
Maximize Board
OK

FIG. 27D



Control panel attached to whiteboard

FIG. 27E(1)

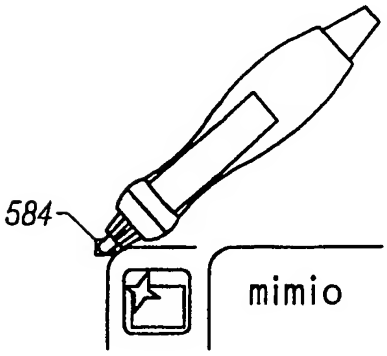


FIG. 27E(2)

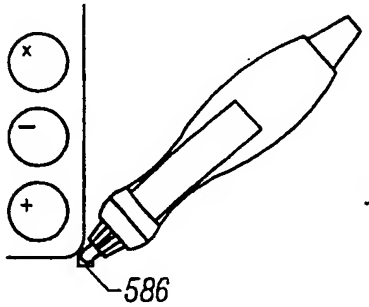


FIG. 27E(3)

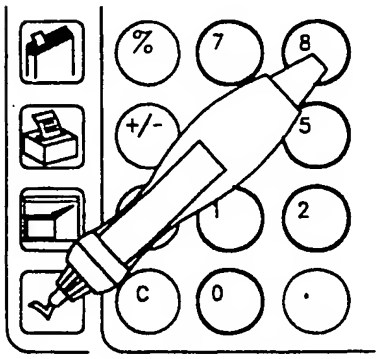
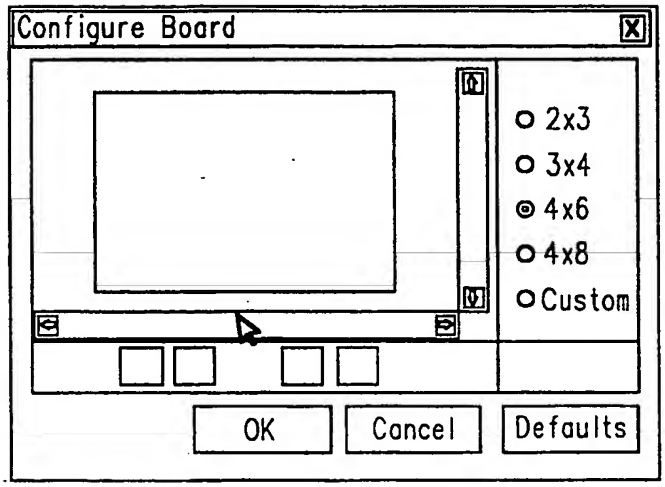


FIG. 27E(4)

FIG. 28A



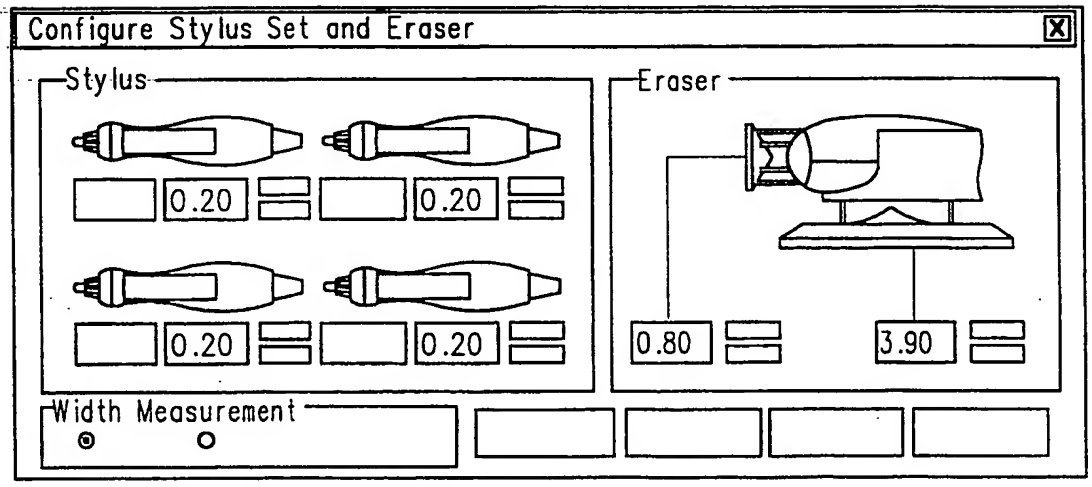


FIG. 28B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/09879

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G09G 5/00

US CL : 345/179, , 175, 178; 178/18.01, 19.01, 19.05.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/173, 175, 178-183; 178/18.01, 19.01, 19.04, 19.05.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 5,298,737 A (PROPER) 29 MARCH 1994, SEE FIGURES 1-3; COLUMN 3, LINES 31-57 AND COLUMN 4, LINES 17-29.	1-4, 40, 47, 52, 54 and 64 ---------- 5-39, 41-46, 48-51, 53, 55-63, 65-78 AND 122-249.
Y	US 4,688,933 A (LAPEYRE) 25 AUGUST 1987, SEE FIGURES 1, 13-15; COLUMN 3, LINES 53-68 AND COLUMN 4, LINES 1-3.	5-39, 41-46, 48-51, 53, 55-63 AND 65-78
Y	US 5,576,727 A (ROSENBERG ET AL) 19 NOVEMBER 1996, SEE FIGURE 1; COLUMN 3, LINES 56-68 AND COLUMN 4, LINES 1-5.	22-24 AND 41-44.

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 16 JULY 1999	Date of mailing of the international search report 06 AUG 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer LUN-YI LAO Telephone No. (703) 305-4873

Form PCT/ISA/210 (second sheet)(July 1992) *

INTERNATIONAL SEARCH REPORT

Inte..tional application No.
PCT/US99/09879

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,107,541 A (HILTON) 21 APRIL 1992, SEE FIGURES 1, 3, 7D; ABSTRACT, COLUMN 2, LINES 27-34; COLUMN 5, LINES 54-56 AND COLUMN 8, LINES 1-6.	79-121
Y	US 5,420,607 A (MILLER ET AL) 30 MAY 1995, SEE FIGURE 3 AND COLUMN 5, LINES 5-16.	79-121
Y	US 5,583,323 A (ZURSTADT ET AL) 10 DECEMBER 1996, SEE FIGURE 1; COLUMN 4, LINES 42-51 AND COLUMN 9, LINES 28-33.	122-249
Y	US 4,777,329 A (MALLICOAT) 11 OCTOBER 1988, SEE FIGURS 1-2; COLUMN 4, LINES 9-24 AND COLUMN 5, LINES 9-20.	244

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/09879

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack Unity of Invention because they are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for more than one species to be searched, the appropriate additional search fees must be paid. The species are as follows:

Species I, as first embodiment(see page 2, lines 2-25 and page 3, lines 13-18);

Species II, as second embodiment(see page 3, lines 19-25);

Species III, as third embodiment(see page 6, lines 16-20);

Species IV; as fourth embodiment(see page 6, lines 11-15;

Species V, as fifth embodiment(see figure 4l);

Species VI, as sixth embodiment(see page 19, 18-28);

Species VII, as seventh embodiment(see page 11, lines 22-31);

Species VIII, as eighth embodiment(see page 13, lines 17-31);

Species IX, as ninth embodiment(see page 4, lines 19-23).

The claims are deemed to correspond to the species listed above in the following manner:

Species I, claims 1-40;
Species II, claims 40-78;
Species III, claims 79-86 and 88-92;
Species IV, claim 87;
Species V, claims 93-112;
Species VI, claims 113-147 and 249;
Species VII, claims 148-171;
Species VIII, claims 172-231;
Species IX, claims 232-248.

The following claims are generic: none.

The species listed above do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons: for example; the special technical feature of species I is a detector with signal receivers and signal focussing elements and the special technical feature of species III is a stylus. Because the special technical feature of Species I is not present in species II and the special technical feature of species II is not present in species I, unity of invention is lacking.

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